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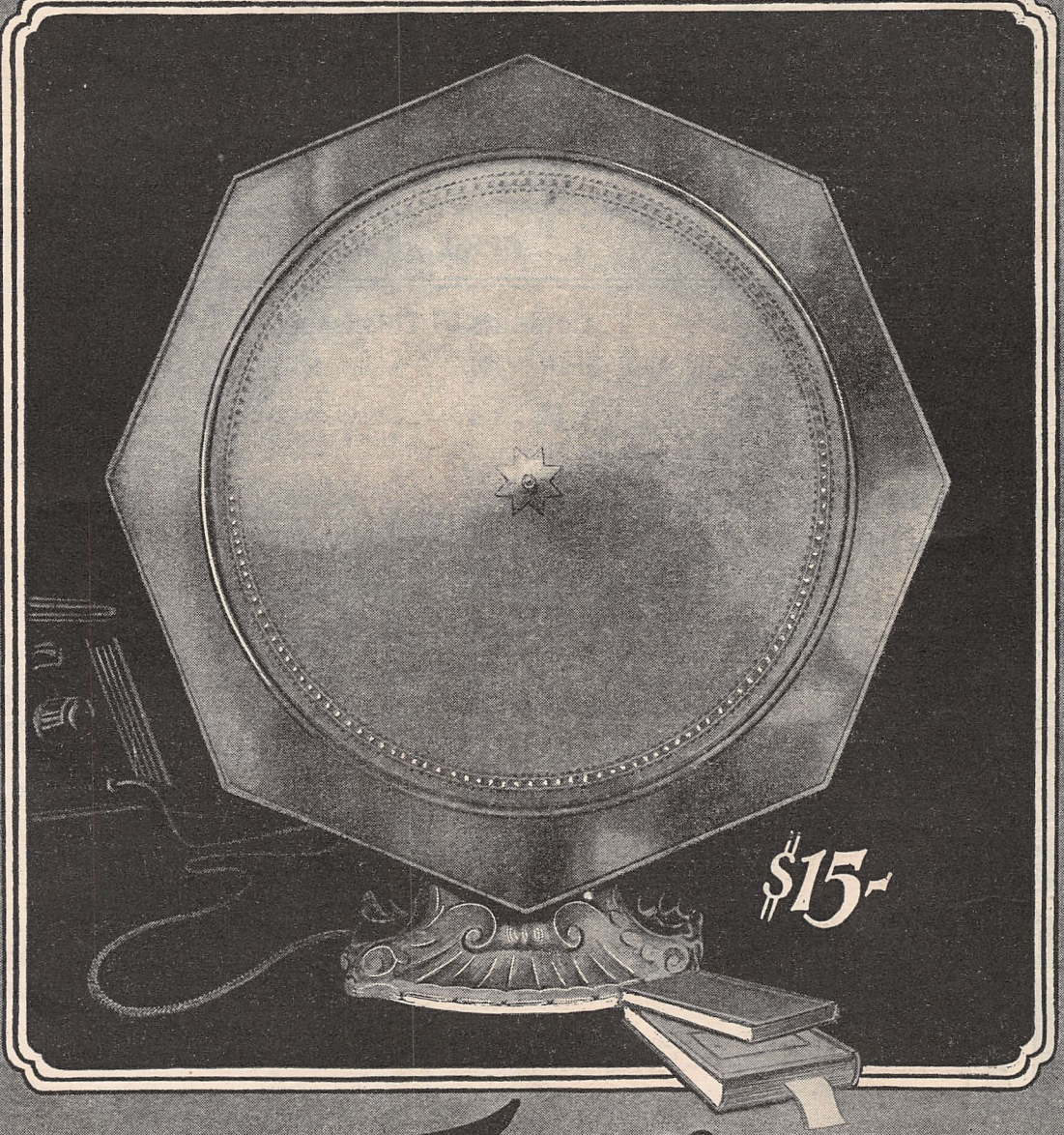

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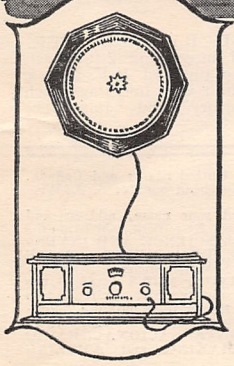

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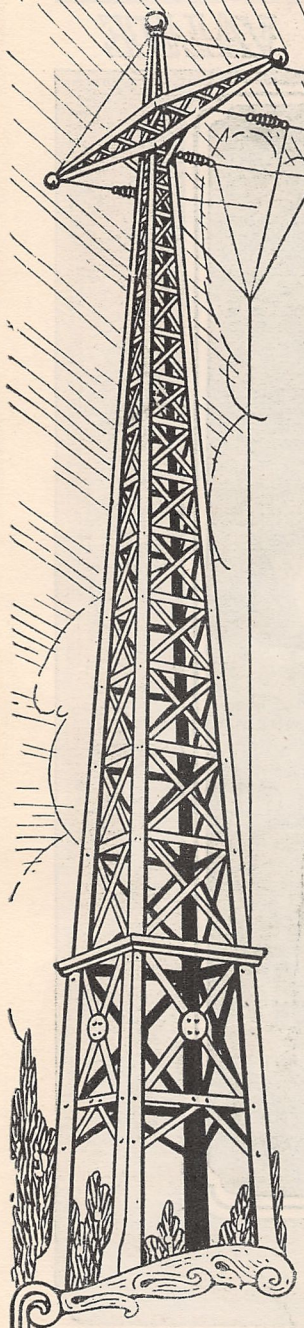

RADIO NEWS

Published by EXPERIMENTER PUBLISHING COMPANY, Inc., Publishers of "Radio News," "Science and Invention," "Radio Internacional," "Radio Listeners' Guide," "Spare-Time Money Making" and "Amazing Stories."

Editorial and General Offices: 230 Fifth Ave., New York City

H. GERNSBACK, President. S. GERNSBACK, Treasurer. R. W. DEMOTT, Secretary.

Member: Audit Bureau of Circulations Radio Magazine Publishers Association

VOLUME 8 APRIL, 1927 NUMBER 10

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SHORT-WAVE EXPERIMENTS WITH ULTRA-VIOLET RAYS
By A. Rechers
Account of very interesting work, utilizing invisible light as a carrier for directional radio transmission.

A LOOP-OPERATED R.F. RECEIVER
Details of a novel and interesting 7-tube set, with one tuned and two untuned R.F. stages, detector, and an audio unit with one stage each of resistance, transformer and impedance coupling.

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All communications and contributions to this journal should be addressed to Editor, RADIO NEWS, 230 Fifth Ave., New York, N. Y. Unaccepted contributions cannot be returned unless full postage has been included. All accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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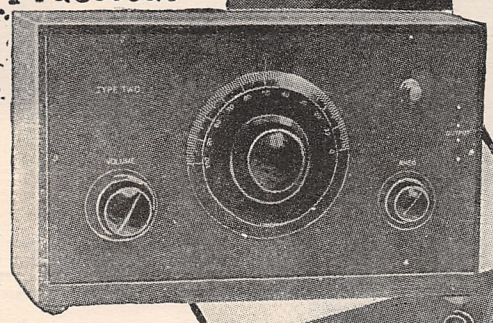

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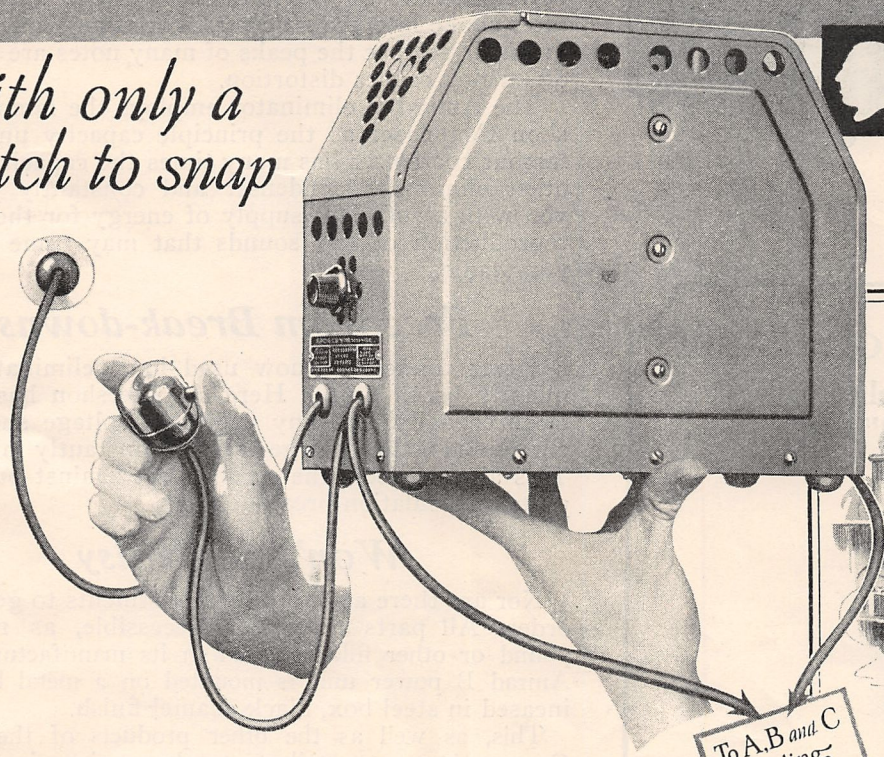

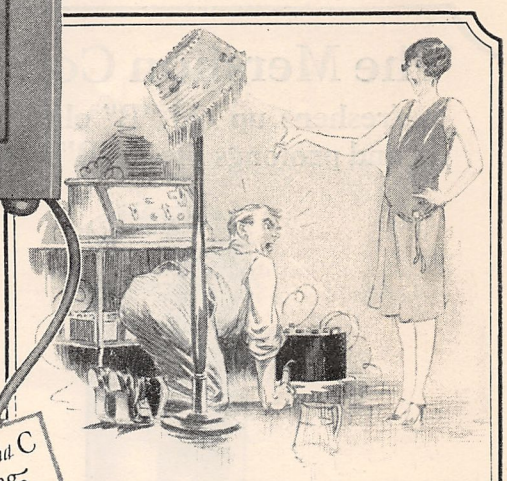

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Crosley sets are licensed under Armstrong U. S. Patent No. 1,113,149, or under patent applications of Radio Frequency Laboratories, Inc., and other patents issued and pending.

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No upsetting the house to have the radio serviced.

NO MORE annoyances from the vital power supply end of your radio. A snap of the switch is the only demand your radio makes upon you from NOW ON.

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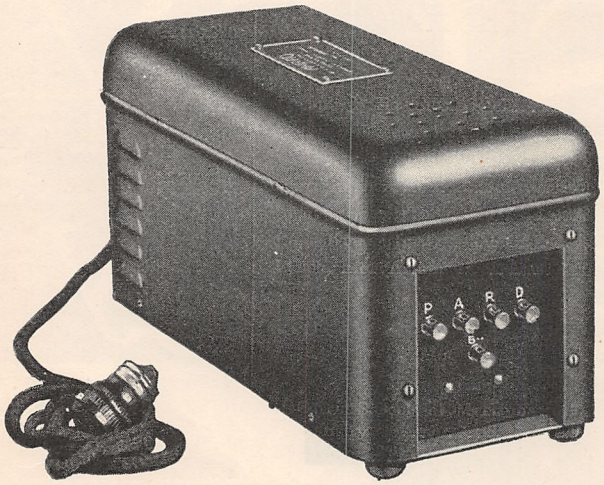

Here's a "B" Eliminator that Equals Fresh New "B" Batteries

B eliminators usually fail to give reproduction qualities to your radio that come from fresh new B batteries. First class B eliminators are usually quiet in operation and supply proper voltage and current, but the reproduction in the loud speaker is faulty because the electrical capacity of the eliminator is not sufficient for the tremendous drain of current extremely loud or low notes demand. Such eliminators must draw the current all the way from the lamp socket through the filter choke into the receiver. The time element is appreciable so that the peaks of many notes are chopped off, which causes distortion.

The Amrad B eliminator employs the famous Mershon Condenser as the principle capacity unit. This famous condenser has many times the capacity of any other eliminator condenser and constantly provides you with a sufficient supply of energy for the correct reproduction of any sounds that may come through your radio.

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Paper condensers now used in B eliminators frequently break down. Here the Mershon has such a large capacity that any excessive voltage surges are eliminated; the charge being constantly absorbed. This also protects the receiver set against punctured parts or insulation break-down.

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Nor are there any variabe adjustments to get out of order. All parts are readily accessible, as no compound or other filler is used in its manufacture. The Amrad B power unit is mounted on a metal base and incased in steel box, black enamel finish.

This, as well as the other products of the Amrad Corporation, are a tribute to the engineering skill of the Amrad laboratories and the influence of mass production methods of Powel Crosley, Jr.

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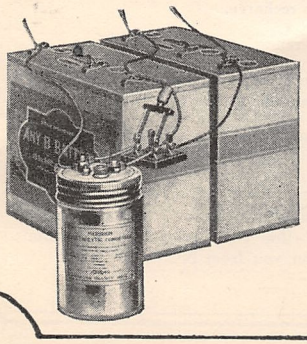
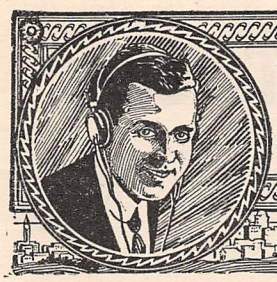
freshens up old "B" eliminators and prolongs life in "B" batteries

The Mershon Condenser assists in more perfect filtering (straining) of the uneven current supplied by a lamp socket. It also acts as a reservoir to store a large amount of energy which is necessary for a continuous smooth flow demanded by incoming broadcasts. This energy such as fresh B batteries deliver must be on tap instantaneously for loud sustained musical notes. The improvement in tone quality is particularly noticeable on low notes.



Mershon Condenser connected across B batteries (with a disconnecting switch) greatly prolongs useful life of these dry cells. It in itself does not wear out—can be used continuously.

$8



RADIO NEWS

HUGO GERNSBACK, Editor and Publisher

EDITORIAL AND GENERAL OFFICES, 230 FIFTH AVENUE, NEW YORK

Vol. 8 APRIL, 1927 No. 10

RADIO STEPS OUT

By HUGO GERNSBACK

THERE was a day, many years ago, when radio was not "radio" at all, but was merely "wireless." The art at that time was merely one of communication; that is, the transmission of intelligence by signals from one point to another without intervening wires. So things stood, more or less, until the advent of the vacuum tube, after which soon followed the first really successful wireless telephone, which today we term the "radiophone," as applied to broadcasting.

Broadcasting itself is, of course, only the propagation without wires of signals to be received at the other end. But radio does not stop here, although the public at large is not aware of the fact that the art of radio is used for hundreds of different purposes aside from broadcasting and telegraphy. The following few remarks may be of interest to those who have not given close attention to the tremendous growth, in every direction, which radio actually has attained.

There was, for instance, the *Dynamophone,* invented by myself and described in the first radio magazine in existence, *"Modern Electrics,"* in the May, 1908, issue, when wireless was just getting into its stride. The *Dynamophone,* as described in that magazine, was an apparatus whereby it was possible, with the human voice, to start an electric motor or any other electrical appliance from a distance. In short, it comprised a microphone in circuit with a relay and condenser, which, in turn, were attached to a battery and spark coil, aerial and ground. At the receiving end I had a coherer and a decoherer, a relay, a number of contacts, local batteries, and an electric motor. Every time a word was spoken into the microphone, the transmitter would be energized, sending out impulses; whereupon the motor at the receiving side would start and run as long as the words were spoken into the distant transmitter. While it was at that time but a toy, the apparatus foreshadowed broadcasting, because this was before the days of the wireless telephone, and the human voice actually did create effects at the receiving end.

. . . Wherein the Editor points out that broadcasting is only one little exemplification of the applications of Radio—recalls a few promising ideas of the pre-vacuum-tube era—and the revolutionary introduction of the three-element audion—a few of the wonders which this infinitely-delicate apparatus has brought about within a few years—what wonders of the near future are to be accomplished by an application of the radio experiments of today—when Radio hits its real stride. . .

Then, at a not much later date, there was the now famous *Ceraunograph,* also described in *"Modern Electrics"* for July, 1908. This was invented by the Rev. P. J. Phillippe, S.J., of Spring Hill College, Mobile, Ala. This was an automatic lightning recorder, and was constructed from the then-existing wireless apparatus. It recorded on a paper tape lightning discharges at a great distance. (It is interesting to note that a very similar device, employing the same principle, is used today by the New York Edison Company at its great Riverside power station in New York to record the approach of thunderstorms many hours before they actually arrive in the city.) Both of these old-time devices were invented, of course, before the day of the vacuum tube.

This marvelous tube makes possible, not only the radio telephone and broadcasting, but also many other important developments. It is really from the time of its advent only, that radio has stepped out from its home sphere and invaded other and older arts, causing and creating many revolutions in them. For instance, up to the time of the perfection of the vacuum tube, it was not possible to talk by wire from New York to San Francisco. The telephonic repeater coils, loading coils and others, as well as the very heavy wire lines necessary for transcontinental communication, made this feat impractical. The vacuum tube changed the situation altogether and today it is used in long-distance telephony to an extent which the public very little appreciates. Here is only one case where radio principles are applied to wire telephony, and make possible the bridging of great distances, impossible to cover otherwise.

A fly hops upon a steel bar, a quarter of an inch square. What happens? Off hand, you will say "Nothing." Just the same, the weight of the fly depresses the steel bar to an extent which can be measured today, impossible as this sounds. The instrument, in fact, measures a *movement of the incredibly short distance of three billionths* of an inch and is called the *"Ultra Micrometer."* It measures distances about 15,000 times shorter than have hitherto been detectable with microscopes of the highest magnifying power. Again, radio instruments and the vacuum tube are called in to achieve the result just cited, because the heavy steel bar upon which the fly hops is but a part of a condenser; and the change in the condenser's capacity, although the fly weighs practically nothing, is sufficient to be accurately measured.

The *"talking motion picture"* would not be a success if the vacuum tube and radio principles were not used in some of the various stages. The same statement is true of the modern phonograph, where both the recording and reproducing are now done by means of radio instruments. One of the most popular new electric phonographs on the market relies entirely upon radio instruments for its reproduction of sound; and a regular radio amplifier with but few changes is used to regulate the music from *pianissimo* to fog-horn volume. And more recently it has been found possible to make the leading violin louder than an entire orchestra by attaching a small microphone to the violin itself and amplifying it to such a degree that the violin will overshadow a 50-piece orchestra without difficulty.

You are probably familiar with the method of trapping thieves by making it impossible for them to approach a safe within three feet, as explained in a recent issue of RADIO NEWS. By upsetting the fine electrical balance of a system of radio instruments, it is thus possible to give an alarm before the burglar or safe-cracker has even touched the safe itself.

There was also described a few months ago, in RADIO NEWS, a method whereby all employees emerging from a factory passed through a certain gate, which would immediately indicate to an observer whether or not the employee carried an excess of metals on his body. By means of vacuum-tube amplifiers it is even possible to detect as small a quantity of metal as the gold in a man's teeth, when he passes through this gate.

A recent invention, also of interest, is the use of a condenser in radio amplification, whereby the small variations in the capacity of the condenser are used to reproduce phonograph music in a way not dreamt of heretofore.

Of the television apparatus so far constructed, practically all of the inventors rely upon radio instruments in one way or another; and you may be sure that, when television finally is developed completely, the solution will be found in the use of radio instruments.

It may be safely said that the surface of what remains to be done has as yet not been scratched. There is hardly an industry today that cannot make use of radio instruments in some phase of its work. When it is realized that by means of radio instruments it is possible that the heart beats of a chicken can be magnified so that an audience of thousands of people can hear the sound throughout an auditorium, it should be apparent how wonderful and how universal the uses of radio apparatus have become.

The applications cited by me are not just freak experiments, for many of them are in actual and constant use, day in and day out.

Though radio instruments have been applied by many fakers to the ailments of the human body, there yet remains to be done a large amount of legitimate scientific work, wherein actual investigation of the functions of the various parts of the human body can be conducted in a way that we do not even dream of.

Mr. Hugo Gernsback speaks every Monday night at 9 P. M. from station WRNY on various radio and scientific subjects.

Receiver Automatically Tunes in Twelve Stations

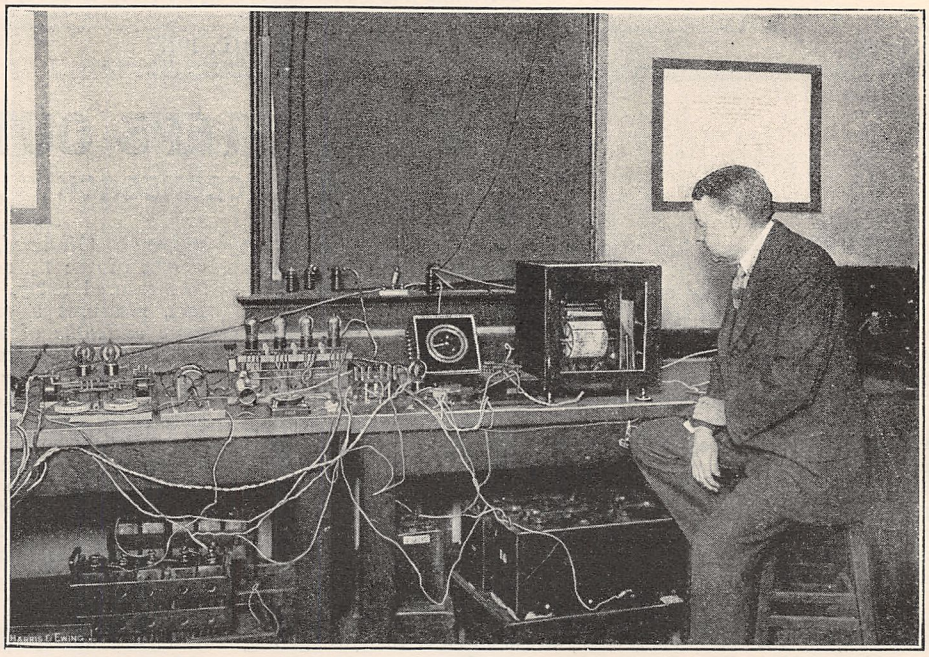
Bureau of Standards Studying Static and Signal Intensity

By S. R. WINTERS

"CLICK" goes a series of instruments and then there is a lingering, buzzing sound! It is, to employ a figure of speech, the "alarm clock" or "dinner-hour factory whistle" of what is probably the only radio receiving station in the world that tunes out one transmitting station and tunes in another automatically, without the aid of human hands.

Furthermore, in this ingenious contrivance where the dials, figuratively, are twirled mechanically, this receiving station may be switching from a transmitting station in Tuckerton, New Jersey, to picking up signals from a transmitting station in Bordeaux, France—clear across the Atlantic Ocean, 3,000 miles distant!

The bewildering spectacle of apparatus required to accomplish this marvelous feat may be seen in the laboratory for special radio transmission research at the Bureau of Standards. There, under the direction of Dr. L. W. Austin, international authority on atmospheric disturbances in radio reception, is a modest young man, whose ingenious mind naturally thinks in terms of the harmonious arrangement of a multitude of little mechanical and electrical units; he is E. B. Judson, laboratory assistant to Doctor Austin, and designer of the mechanism here described.

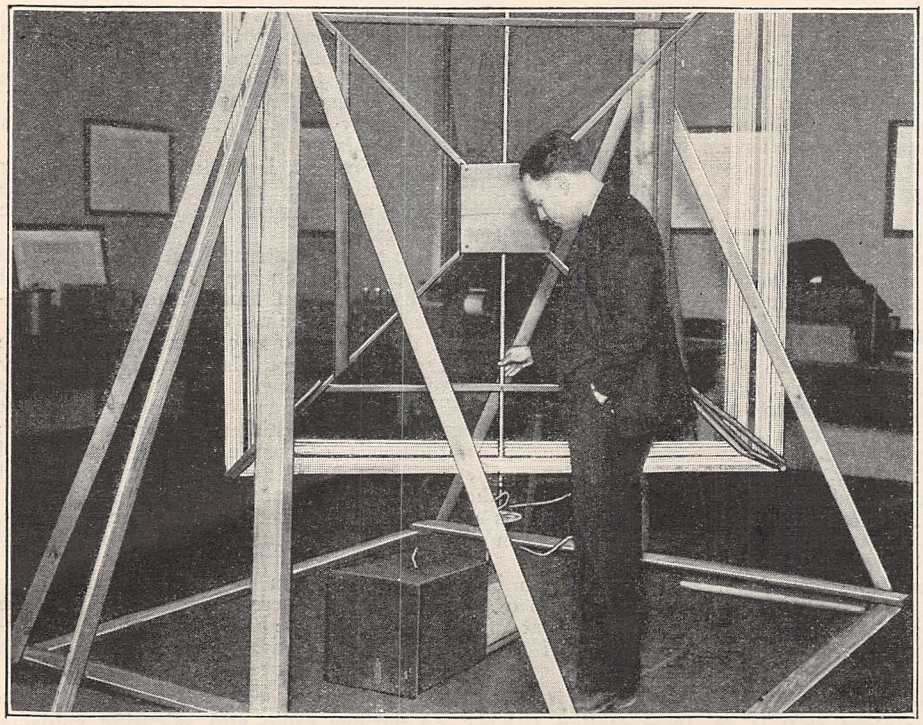


Dr. Austin and the automatic receiving equipment. Notice the recorder with the cylinder covered with graph paper, upon which is made a permanent record of the signals.

SIGNAL STRENGTH RECORDED

The apparatus is completely automatic in making records of the pranks of static and the intensity of radio signals on long waves, from 16,000 to 25,000 meters. It can be operated day and night continuously, without the presence of an operator, and leaves the "finger-prints" of static or signal intensities for observation and interpretation by an observer when convenience permits. Or, if desired, readings on the automatic record sheet may be taken any five minutes during the hour. The needle on a galvanometer, which is enveloped in a complicated array of mechanism, drops downward once every thirty seconds and in doing so strikes an ink-saturated thread. The latter, coming in contact with the record sheet, wound on a cylinder, makes characteristic scrolls—"dips" or "rises"—by means of which static or signal strength may be studied.

This apparatus is too complicated in its arrangement and too vast in its bewildering array, spreading over several laboratory tables, to permit of a detailed description in an article of this character. Suffice it to say that there is a series of clock-controlled relays, an amplifier, and the recording mechanism itself. The clock-actuated mechanism, however, unlike the clock often attached to the broadcast listener's receiving set for turning on the radio receiver, is an auxiliary device in accomplishing that uncanny feat of tuning out one transmitting station and tuning in another. By means of a succession of relays, it is possible to obtain records from as many as twelve transmitting stations every five minutes by this automatic process, either day or night. The recorder itself completes one revolution in either two hours and five minutes or 25 hours, depending upon how it is timed.



Mr. E. B. Judson and the automatically-revolving loop antenna which he designed. This is used with the apparatus shown above.

LOOP FOR STATIC DETECTION

Our wonderment is further increased when we observe the automatic behavior of a large loop antenna revolving around its axis with measured strides, in the meantime noting the direction from which static is coming at the moment. This wooden frame, about five feet square and containing 60 turns of cotton-covered wire, makes a complete circle of 360 degrees once in twenty minutes, being operated through a set of reduction gears by an electric motor which makes 1,800 revolutions per minute. This automatically-operated loop, for studying the directional characteristics of atmospheric disturbances, was likewise designed by Mr. Judson.

Dr. Austin, in commenting upon the purposes of this entire automatic equipment, indicated that without it the services of two additional laboratory workers would be required in order to study static and signal intensities day and night. Born of the extremity of the lack of sufficient funds with which to employ the necessary personnel,

(*Continued on Page* 1292)

A Temperamental Artist—Radio Mike

An Interesting Sidelight on Musical Problems in a Broadcast Studio

By EARL SOWERS

GIVE your favorite broadcast station a chance, even though the program does not sound just as you think it should at the beginning of the evening's entertainment—the first five minutes are the hardest.

In five minutes it is possible to move the "mike," shift the orchestra, get a very good idea of the kind of air that fills the studio, or do any one of a half hundred—or more, if necessary—things that will very nearly assure you of a pleasing program during the remainder of the evening. And, remember, poor transmission is no secret to those on duty in the station and that they probably discovered it before you did and are already working to overcome the trouble.

The same arrangement of an orchestra seems to "Mike" harmonious one evening, and discordant the next.

Most of us know that the microphone is now located as per blueprint—the result of hundreds of tests and experience in scores of studios—but conditions change from day to day and there are always the unexpected "freak" occurrences. It is these which cause the anxiety in the studio and transmitter room when the lights flash and "power" is cut into the antenna system that is radiating to perhaps a million listeners.

Radio always has been full of freaks. They were there galore back in the old days of the first audions. Today high power and more efficient equipment have eliminated many of them, only to make room for still new ones in unexpected places.

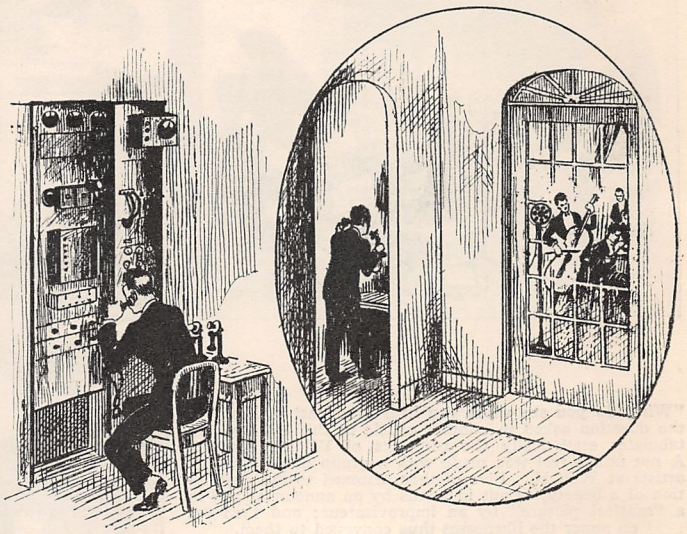
So critical now are the station operators and the invisible, but no longer silent, audience that no two orchestras or soloists may be broadcast in just the same way. Quite often the same orchestra cannot be broadcast more than one time on the same general layout of musicians and microphone location. This, no doubt, sounds like gross exaggeration, but it is a fact, nevertheless, in more than one studio.

PROBLEMS OF THE STUDIO

In addition, there are the less bothersome details of adding or subtracting rugs on the floor to "tone" down "highlights" or to "pull" up the "low places"; the shifting of silencing draperies that cover the walls of the studio, and changing the location of the mike.

The latter may be moved from the center of the studio to one corner, then to another. It may face the orchestra or have its side or back turned to the musicians. When placed in a corner it may be hidden behind the drapes of the sidewall. One voice is "brilliant," another "dark," and so they require different treatment in the pick-up; but just how different is dependent upon many factors.

All the troubles of a broadcast station are not over when the orchestra crashes into the opening number; in fact, some of them have just begun. The operator on the roof has been listening in with a "monitor receiver," and he has just called the announcer's assistant to say that the microphone is having a temperamental spell; and that some change in the arrangements must be made immediately in the interests of improved modulation. There is no preliminary test which will discover this: but the broadcast station's staff will know there is something wrong before the first listeners have a chance to turn a dial. The writer explains a few of the studio problems, a better understanding of which will make the reader more sympathetic with his entertainers.



There are the air conditions in the studio, of which more will be said later, and the artist may be unnatural from nervousness and pitch the voice higher than is expected. These and many other things must be discovered *after the program starts.* The 1,000-watter does not sign off for fifteen minutes while making the discovery, and

At times the best modulation is obtained by setting "Mike" on the piano itself—

therefore, the first five minutes are the hardest.

Sometimes the studio may be a little bit cold for an afternoon broadcast in the middle of the winter; and when it begins to warm up there is more trouble. The orchestra must change its "shade." This happened recently in a studio. The first thirty minutes were fine and then the buzzer from the transmitter room on the roof began to sound like an SOS.

"What's happened down there?" demanded the outraged operator. "Up here it sounds like all the tin pans in town have been let loose. For the love of Pete, see what you can do about it, will you?"

The announcer knew that there had been no change in the way the orchestra was performing. Every man had broadcast many times before and knew how to keep the volume level that was requested. Groping in the dark for a moment, the announcer had them tone down their next selection, and then the operator reported the transmission perfectly clear and satisfactory. After that there was no more trouble from that source.

Later we tried to analyze the trouble, but the only goat we could tag was the air in the studio.

REAL "ATMOSPHERIC" PROBLEMS

So many of these freaks are developing lately that some are beginning to dream about temperatures and humidity. One studio is new and supposed to be the most modern devised; there is an excellent forced-draft heating and ventilation system, but there are some unsolved problems that might be explained if a miniature weather bureau was set up there. The writer thinks so and is gaining a few converts. Maybe they'll get the weather bureau before they get through.

Does the temperature of a studio, where the artists are in no danger of suffocation or frost-bite, have anything to do with the carrying power of the air between the artist and the mike?

Does the amount of humidity have any direct effect on the acoustic properties of the same air?

Do these two elements affect the walls, ceiling and floor of the studio and make them more or less vibrant? Even when the floor is oak, the walls concreted with an overcovering of "monk's cloth," and the ceiling is of felt composition?

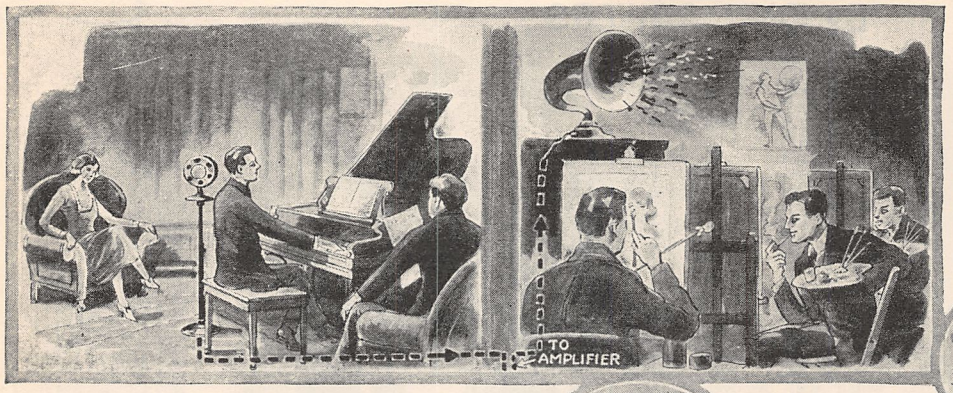
Take this illustration. There is an orchestra which plays from a certain station every two weeks. It is composed of the

(*Continued on Page* 1278)

And, at others, it is necessary for him to stand back several feet, or the result will be atrocious.

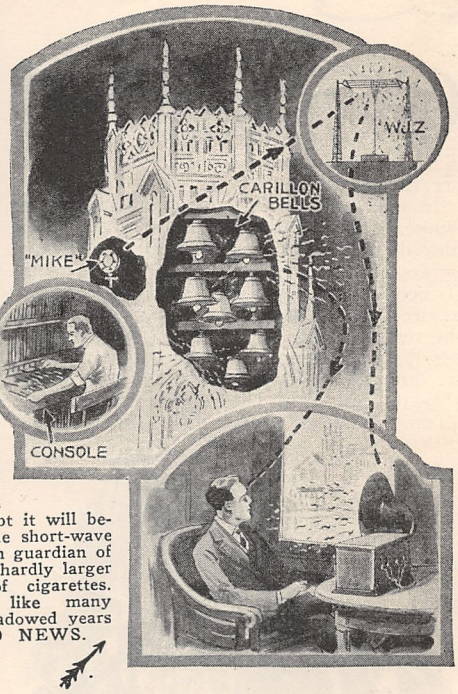
Radio News of the Month Illustrated

By GEORGE WALL

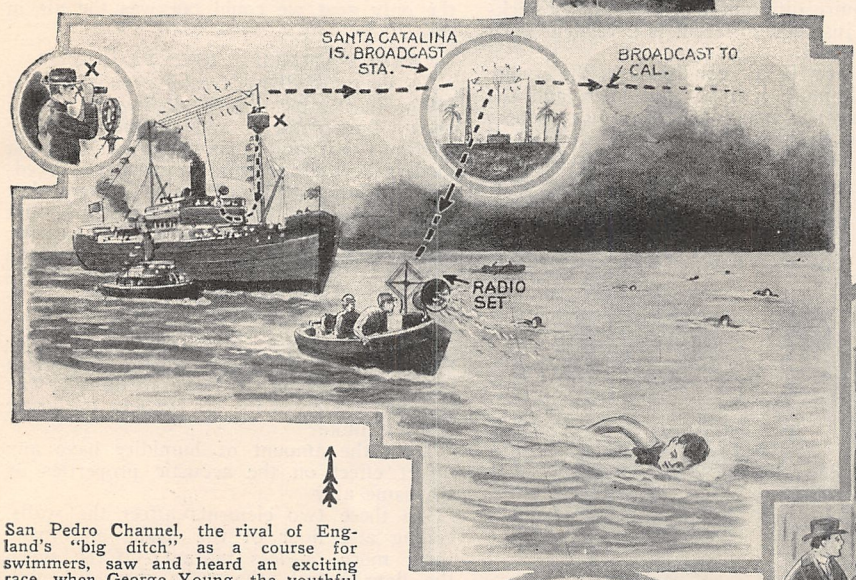


"What do you see when you hear broadcast artists?" is the question asked in another article in this issue, which tabulates statistically the reactions of WRNY readers. A not unlike test was made with a group of professional artists at WPCH. Five of them listened to the description of a beauty, as put in words by an announcer and in a "musical picture" by an improvisateur; and then set on paper the likenesses thus conveyed to them.

The radio-equipped policeman is now a fact in Passaic, N. J., and if the experiment proves successful, no doubt it will become general. The short-wave receiver which each guardian of the law carries is hardly larger than a packet of cigarettes. This invention, like many others, was foreshadowed years ago in RADIO NEWS.



How fast radio signals travel is illustrated here. The listener, sitting with his set turned on, is listening to the carillons on Park Avenue, New York, which are being broadcast also from the transmitter at Bound Brook, 30 miles away. He hears first the radio music, and then the bells themselves, half a mile away, coming in softly like an echo. It takes the sound waves two seconds to come. while the electric waves have made their double journey in one six-thousandth of the time.



San Pedro Channel, the rival of England's "big ditch" as a course for swimmers, saw and heard an exciting race, when George Young, the youthful Canadian, was the only successful entrant among more than a hundred men and women who battled to cross the 22-mile channel. A multiple broadcast was maintained during the course of the race. The short-wave (105-meter) transmitter of KNX, 6AX, was mounted on the big steamer Avalon, which served as mother ship for the tenders during the race. Over this Edward Albright of KNX announced the progress of the swimmers. The short waves were picked up, rebroadcast by KNX at Hollywood and KFWO, the station of Major Lawrence Mott on Catalina Island, on 337 and 211 meters respectively. This in turn was rebroadcast by eighteen other stations, making an unprecedented etherial chain. At first difficulty was experienced by the fact that the bay where the start was made is in radio parlance, a "dead" spot, and interference was caused by the long-wave commercial transmitters. Under these circumstances the broadcast was begun, and maintained through the nearly 24 hours of the great swimming race. Many swimmers were entertained by radio from the small boats attending them, as shown above, and thus sustained against the mind-killing monotony of the prolonged repetition of their exertions. They were also thus advised of the progress of the race.

Above is a picture of the corner of Greenwich and Cortlandt Streets, New York City's "Radio Row," where one radio store follows another, with their counters obstructing the sidewalks and blaring loud speakers compelling the attention of every passer-by. Here is where the commuter on his way home shops for the parts which will busy him that evening; and the office boy with his pennies finds all the thrill that his mother does in a bargain sale. Here, also, is the graveyard of countless unsuccessful ventures in radio manufacture.

At the left, we see the ingenious device of a fan in Belfast, Northern Ireland. Unlike Franklin, he is fishing for DX, not lightning. With a 2,500-foot piano-wire aerial, he claims to have heard America with a simple crystal set.

Radio Finds Its Cagliostro

How a "Radio-Controlled Automobile" Was Faked

By KNOX BAXTER

ALMOST as soon as any new scientific achievement catches the public's fancy, it seems as if there are dozens of people who are only awaiting the opportunity to hatch a scheme whereby they can bamboozle some innocent victims out of a lot of their hard-earned cash.

For instance, readers of RADIO NEWS will remember the Kirovox exposure. The Kirovox was a so-called radio instrument for detecting various diseased portions of the human body. Radio-frequency currents were supposed to encounter greater resistance in the diseased sections than in the healthy, showing up the changes in current strength on meters. When it was opened, the cabinet was found to be partially filled with miscellaneous radio junk. The whole thing was nothing but a bunko game.

Another such scheme has just been exposed.

About two years ago the United States Army demonstrated a motor car which ran about the streets of Washington and which was controlled by radio from a car behind. A short time later a student in a Western college likewise equipped an automobile with radio apparatus and controlled it entirely by radio waves. These demonstrations were duly reported in RADIO NEWS and were absolutely authentic. This meant that thousands of people interested in radio all over the world knew that it is possible to guide an automobile from another car by radio.

WORKING THE RACKET

About this same time, when people had this idea before their minds, a schemer wished to pick up a little easy money. The story goes that he went to a prominent automobile dealer and told him he had a great advertising scheme; he would drive two cars across the country, one being controlled by radio from the other, a distance in the rear. He would install the radio apparatus in both cars and make all the necessary changes in the controls and mechanism; all he wanted was the cars. These he obtained.

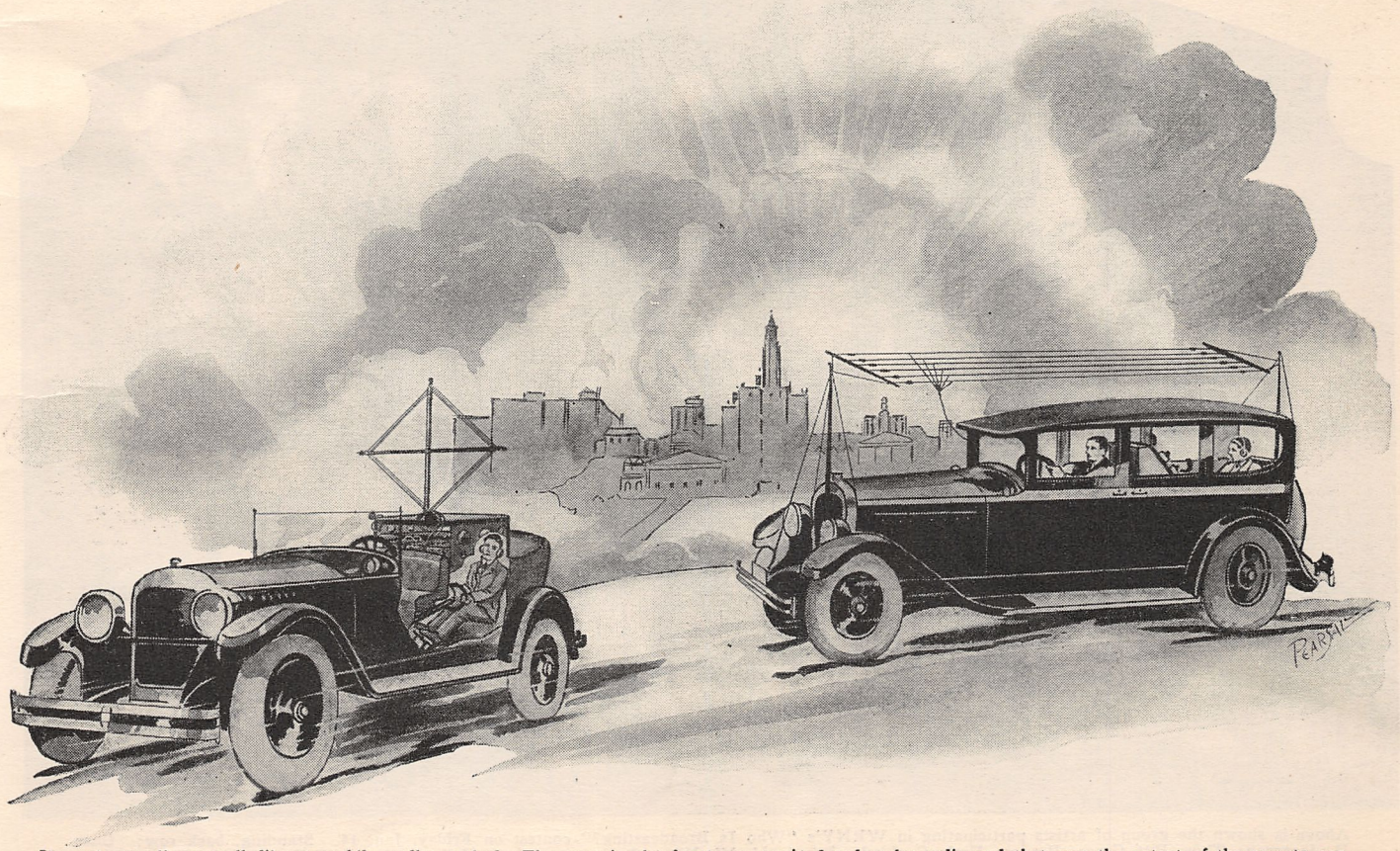
Soon there appeared on the streets of New York City two automobiles, one following the other. The front car had no visible driver, but on each car there was a radio antenna. Then the cross-country tour started. Small towns were visited and local merchants taxed for having their names and wares displayed on the cars as they rolled about the town. My, how the cash rolled in.

Before the two cars would pay their visit to a town—and the one selected was generally one in which a fair, carnival or radio show was being held—an advance agent would hire four or five local workmen who were familiar with automobiles and radio. These men were required to pay a deposit of fifteen dollars to the agent before they got a job, which job was worth twenty-five dollars a week. Then the merchants were visited and such a good opportunity to advertise was seldom allowed to pass by. For this opportunity they contributed, to the rapidly-increasing bank account of the faker, six hundred of Uncle Sam's well-known dollars for each exhibit of the "mystic powers of radio."

But, as usual in a scheme such as this, the schemer got careless or too greedy. One of the helpers, whom he hired in an inland city, squealed. The front car was not controlled by radio, in the sense that the cars designed by the army officers and the Western student had been. This automobile had a driver concealed under the apparatus in the front car and he received by radio the directions from the rear car, the discharged helper said. It might be construed that the front car was "controlled by radio," but such a statement is far fetched. When one says that anything is controlled by radio he does not ordinarily mean that there is a person manually operating the controlled object.

The gentleman who foisted this scheme upon the public styled himself "Houdina," which if one thinks about it for a moment will seem satirical, as the man whose name he so closely copied spent many years of his life in exposing just such fakes as the one outlined above. In this case the National Better Business Bureau was the exposer of the fake.

This sort of thing seems to be one of the favorite games of the bunko artist. Ever since the earliest times there have been wonder-workers and legitimate fakirs (please note the spelling); but when "Chevaliers of industry" can be designated by the latter appellation, which in that case is spelt with an "e", then we are only too glad to be able to tell the public how they do their stuff.



How the "radio-controlled" automobile really worked. The man in the front car received orders by radio and that was the extent of the remote control. Yet an application of true radio control to guide a car is a perfectly practical feat in radiodynamics. More than that, the U. S. Army has not only driven cars, but flown airplanes by radio remote control. The fakers, therefore, are giving a fraudulent imitation of a genuine radio demonstration.

What Do You See When You Hear Broadcast Artists?

An Analysis by CHARLES D. ISAACSON, Program Director, Station WRNY

WHILE I was traveling around the country on lecture tours, invariably I would encounter some such comment as this, "Do you know, I thought from your writings that you were *much older* and that you had a *beard!*" That was an impression derived *from my writings.* What of the idea of the speaker conveyed by the *voice?* The question now arises as to the pictures of radio artists which listeners form. If fans see the stars in the flesh, will they be as imagined, or will there be a pleasant, or unpleasant, shock to the senses?

Last month at WRNY, we tried an experiment which was aimed to learn the secret. It is a known fact that blind people have definite impressions of everything and everybody about them. Not only do they recognize personalities, but they can also quite clearly define the characteristics of each individual. This "second sight" works down to such details as colors and facial descriptions. In a sense, all radio fans are listening to programs in the dark. It is as if a singer appeared upon the stage, the lights went out—the house pitch black. You think: "Oh my, what does she look like—is she beautiful, is she tall, short, dark, blonde, what?" Suddenly the lights go on. What do you see?

When television comes, will it lessen the pleasure of many listeners, whose imaginations picture goddesses and Apollos? When you can see over the air, as well as hear, will the artists be just as interesting, less, or more so?

These were the thoughts behind the recent experiment at WRNY, "Who Is Broadcasting?" The whole thing developed out of a chat with Martin Porter, the interesting radio reviewer of the *New York American.* Porter and I get together every once in a while to analyze the radio situation, and praise or condemn some of the current tendencies in broadcasting.

Well, Porter really is responsible for this new investigation into broadcast phenomena; and this is the way we went about it:

There were twenty of us who were to go before the jury of listeners. I inveigled three of the WRNY staff beside myself to take the chance of being considered old, young or indifferent. Then I went out to get contrasts. Thomas Pitt Grace, the poet, is over sixty and tall. Muriel and Audrey Goodman are seven and nine, respectively and correspondingly tiny. Annette Chaimowitz has prima donna proportions and Mildred Wallack is a petite dancer. In other words, there were the proper contrasts.

We gave each of a list of twenty only about three minutes at the microphone. That time was too short. The twenty artists were too many. That complicated matters. That we learned after we had staged the affair.

We are repeating our investigation, but are reducing the number of artists to four and are keeping each of them longer at the microphone, to enable the listeners to become better acquainted with the voices.

However, what we have learned is significant and quite astonishing. We received about seven hundred answers, about half of which declared the list was too long for writers to keep up with us, as they put it. In other words, the test was too hard for them.

We had, therefore, three hundred usable letters, which we collated and analyzed.

WHAT THEY LOOK LIKE

The formula we had set for each "reading" was as follows:

1. Name and number of entry.
2. Color of hair.
3. Color of eyes.
4. Height.
5. Weight.
6. Age.
7. Nationality.
8. Characteristics.

The way we had filled out three cases accurately was as follows:

1. Mildred Wallack (No. 7).
2. Hair, black.
3. Eyes, black.
4. Height, 5 feet, 4 inches.
5. Weight, 105 pounds.
6. Age, 16.
7. Nationality, Russian-American.
8. Pretty, vivacious, humorous, graceful, a dancer.

---

1. Earl C. Little (No. 11).
2. Hair, black-gray.
3. Eyes, gray.
4. Height, 6 feet, 2 inches.
5. Weight, 175 pounds.
6. Age, (about 45).
7. Nationality, American.
8. Looks like Woodrow Wilson, very masculine, very gentle, concise.

---

1. Annette Chaimowitz (No. 16).
2. Hair, brown.
3. Eyes, brown.
4. Height, 5 feet, 6 inches.
5. Weight, (about 190).
6. Age, (about 20).
7. Nationality, Russian.
8. Happy, round, rosy face, sympathetic, modest, kindly.

These three will give you an idea of the variety of the twenty broadcasters.

(*Continued on Page* 1291)

Above is shown the group of artists participating in WRNY's "Who Is Broadcasting?" contest on Friday, Jan. 14. Standing, back row: Chas. D. Isaacson; Thos. Pitt Grace, Reader; Earle C. Little, Basso; H. W. Niles, Baritone; Alfred Hall, Baritone; Prince Piotti; Ralph Christman, Pianist; Harrison Chatfield; Frank Malloy, Reader. Second Row: Ruth Sharpe, Stories; Eileen Mize, Reader; Bernardine Gratten, Soprano; May Sehnert, Songs; Martha Sehnert, Songs; Lucille Husting. Annette Chaimowitz. Front Row: Mildred Wallach, Dancer; Muriel Goodman; Audrey Goodman; Muriel Ellis; Mitzi Salzman.

Radio Aids Movie Director

Impromptu Radiophone Controls Action of Giant Movie

By JOSEPH RILEY

SCENE: Hilltop overlooking broad stretch of beach dotted with palm trees. Offshore several battleships, transports, tenders, rowboats, etc. In the foreground, large packing case, beside which is seated a serious-looking man. This man is someone of importance, as is evidenced by the attention paid to whatever he says by the group of men surrounding him. Scattered over the beach are crowds of Cubans, men, women and children.

THE MAN: Is everything all set? (*Group surrounding him bustle about.*) Are all the camera men prepared? (*Business of looking about with field glasses.*) Hello, on the battleships, are you all set? (*More business with field-glasses.*) Hello, on the beach, all ready? Cameras, ready? All right then, sound the siren.

(*A large hand-operated siren whistle behind The Man starts its weird wail and the crowds of people on the beach hurry to certain positions, where they remain as if turned to stone. Stationary white dots along the battleships' decks indicate sailors "at attention." Suspense.*)

THE MAN: All right, let's go! Ready, cameras? Ready, everybody? Right! CAMERA!!

And from that moment a perfect torrent of words issues from The Man directing the movements and actions of hundreds of people, the battleships, the boats that are filled with Rough Riders and sailors. He orders the Cuban men to run into the water and in an instant the surf is full of gesticulating, shouting Cubans, while their wives shout and wave their arms on the beach and children shout, too and stare wide-eyed at the boats nearing the shore. He speaks again, and men aboard the transports shove horses and mules into the water, the animals swimming toward the beach.

The boats, heavy with troops and supplies, sweep in on high, white-crested breakers. Some of them capsize and the soldiers fight their way through the surf, weighted down by their packs, guns and cartridge belts. Cubans help run the craft up on the beach. Horses and mules are caught as they came dripping from the water. Boxes and bales and supplies are piled high on the sand. Long lines of soldiers form on the pier jutting out in the water.

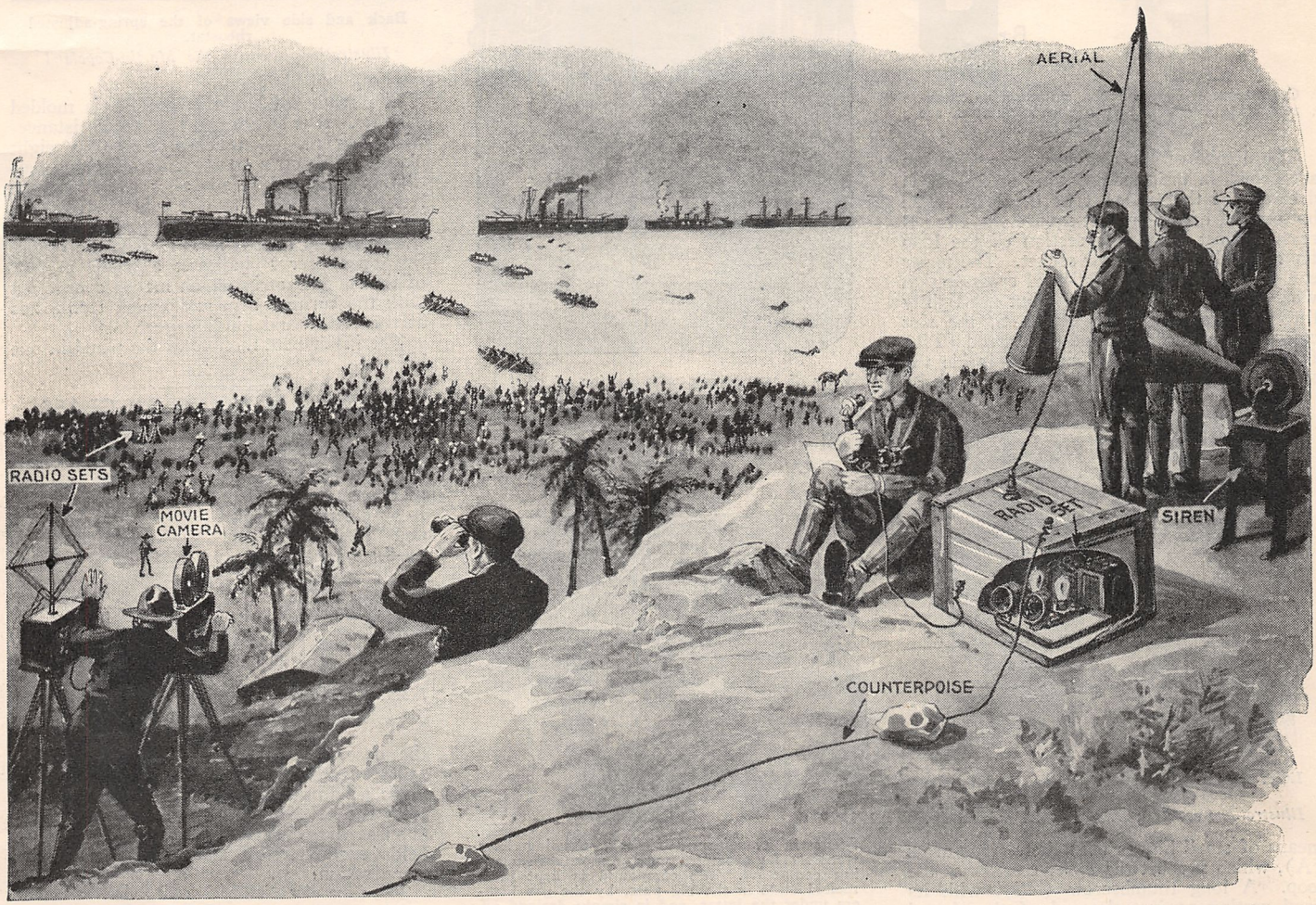
As can be guessed by the reader, The Man is none other than a motion-picture director putting in a very busy morning, but the interesting part of the whole matter is contained within the rough packing case beside which the director is seated. In this case is a short-wave radiophone transmitter, for in no other way had it been found practical to transmit the many orders to the widely separated actors in the gigantic scene, depicting the landing of the American Rough Riders on Cuban soil, of a new motion picture.

IN the filming of a motion picture radio has been introduced as a powerful ally, and it was recently announced that motion pictures are again borrowing from the accessories of the radio, when the record of the music accompanying the action is photographed on the same film. The reproduction of the music in such a system utilizes vacuum tubes, coils, transformers and loud speakers. Perhaps, in the very near future, we shall have films with scenes such as the one below, and the actual sounds of the landing and greetings of the natives audible in the theatre. —EDITOR.

HOW IT WAS DONE

The transmitter, which was operated on a short wavelength, did not need to be very powerful, as the distance to be covered was relatively small. A post was erected for the antenna and a counterpoise was laid along the ground and held down by rocks. The director, by speaking into the hand microphone, could easily communicate orders to any of the battleships, transports, or the crowds,—there being radio sets and loud speakers hidden along the beach. Orders were transmitted to the small boats by powerful loud speakers hidden at the end of the pier. Beside each cameraman was a loop receiver, orders coming to him through the headphones he wore.

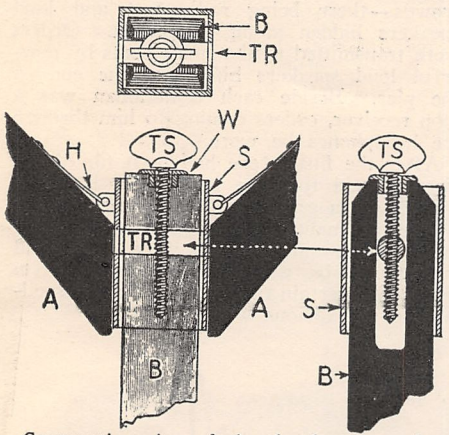
After the final scene had been filmed the director said that the method he had employed was a great deal easier than the old system of manual wigwagging. Here, by radio, orders and directions were transmitted instantaneously, while with the old system naturally a certain time had to be spent spelling out the various words by code.



By means of a short-wave radiophone transmitter the director of a Paramount motion picture, depicting the landing of the Rough Riders at Daiquiri, Cuba, gave orders to the host of actors and actresses; controlled the movements of the battleships, transports and tenders, and told the cameramen when "to shoot" and "cut."

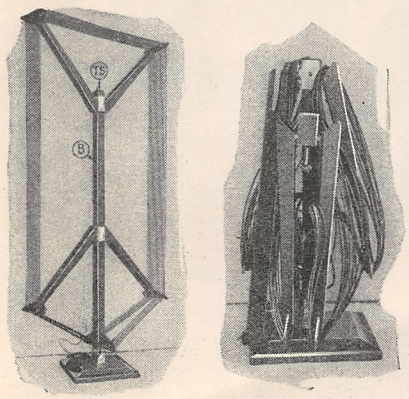
THUMBSCREW KEEPS WIRES OF LOOP STRETCHED TAUT

MOST collapsible loop aerials are notoriously deficient, in the respect that after they have been opened and closed a few times the wires become wobbly and sometimes slip out of their retaining grooves altogether. This fault is overcome in a new loop which possesses a thumbscrew adjustment feature that keeps the wires always taut and perfectly in line when the device is set up for use. The fact that the wires can be maintained at a uniform separation insures the accuracy of condenser calibrations and permits specific dial adjustment for any wavelength.



Cross-section view of the thumbscrew mechanism by means of which the loop wires are kept straight and tight.

The details of the thumbscrew mechanism are shown in the accompanying cross-section drawing of the top part of the loop. The bottom end of the upright square wood bar B rests against the lower section of the loop frame work, in a shallow socket. The upper end is slotted, as the right-hand cross-section view shows. It slides snugly but not tightly through a square brass sleeve S, the slot clearing a small drilled and tapped rod (TR) fastened in a horizontal position inside the sleeve. To the sleeve itself are fastened, by



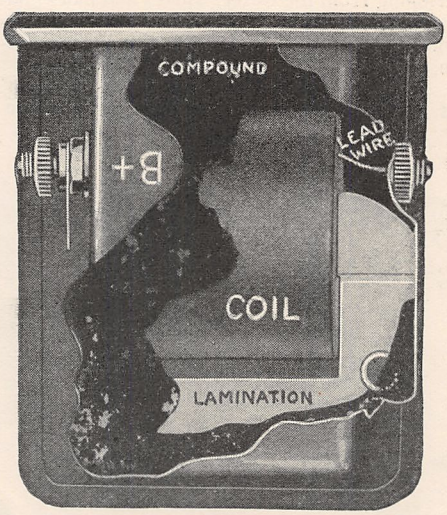
Left: The loop erected for use. Right: the loop as it appears collapsed.
Illustrations courtesy Duro Metal Products Co.

means of small hinges (H) the oblique arms (A), which support the upper corners of the loop. A long thumbscrew (TS), with its head resting against the end of the slotted bar through the medium of a washer (W), turns into the rod TR. As this screw is tightened, or turned inward, it causes the bar, and hence the sleeve, to rise upward. This upward movement naturally stretches the loop wires into the proper position.

The loop is designed for use with a .0005-mf. condenser, and is provided with a center tap for certain superheterodyne circuits. Its dimensions are as follows: erected, height 34 inches, width 16 inches, depth 3¾ inches; packed, 4½x7x14 inches. The woodwork is finished in walnut; all the metal parts are heavily nickel-plated. The wire is stranded, and covered with silk braiding. The four corners of the loop base are equipped with felt pads which prevent the instrument from scratching table or cabinet tops.

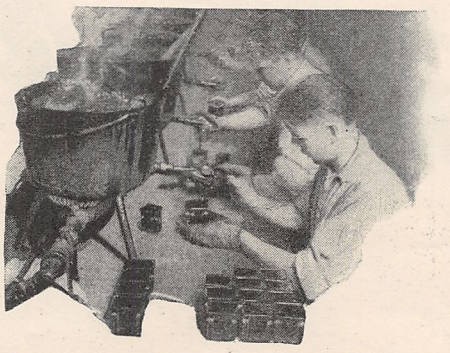
TRANSFORMERS NOW MADE MOISTURE-PROOF

A PROMINENT manufacturer is now hermetically filling his audio amplifying transformers with a moisture-excluding compound, which seals them practically forever against the inroads of rust and electrolysis. Several instruments selected from stock for



View of transformer with section of shell cut away and portion of compound removed. Every component part of the instrument is sealed.

a test operated perfectly after having been submerged in water for a period of thirty days.

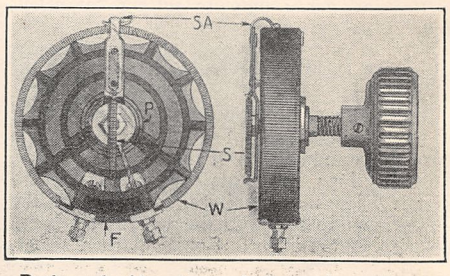


Scene in transformer factory, showing how transformers are filled with a moisture-excluding compound. The compound is kept in a melted state in the big pots, by the gas heaters under the latter, and is simply drained off by means of a spigot.
Illustrations courtesy the All-American Radio Corporation.

In the factory, each transformer, after it has been completely assembled, is turned upside down and filled to the brim with a warm, syrup-like compound which quickly hardens into a solid mass. The instrument is based and is then ready for use.

SPRING ON ARM OF RHEOSTAT MAINTAINS EVEN CONTACT

IN a new rheostat constant and even pressure of the rotating contact arm on the resistance element is maintained by a small coiled spring pulling on the contact member of the arm. This feature practically eliminates the trouble usually caused by uneven expansion of the resistance when it heats up under load; and thus permits smooth and even adjustment of the instrument at all times.



Back and side views of the spring-adjusted rheostat.
Illustration courtesy the Martin-Copeland Company.

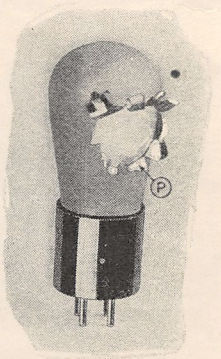
The frame of the rheostat, F, is molded bakelite. It is so formed that the resistance-wire element, W, touches it in only eight places. This open construction provides ventilation for the wire and allows any heat the latter may develop to dissipate itself in the air.

The sliding arm is marked SA, the spring S. The letter P indicates a coiled pig-tail of thin copper strip which makes connection with the turning arm and which terminates at the right-hand binding post.

The instrument mounts to the panel in one hole.

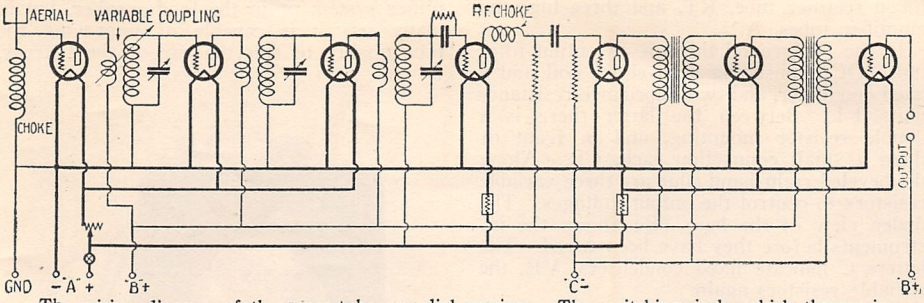
COPPER PLATING ON GLASS SHIELDS TUBE

THE glass bulb of a new three-element vacuum tube is shielded by a film of copper deposited on it by electrical means, and "grounded" to one of the filament tips in the base, thus acting as an effective electrostatic shield which protects the tube against transient electrical fields encountered under certain conditions of operation.



The shielded tube, with some of the copper plating (P) peeled away to reveal the glass beneath.
Photograph courtesy Moulded Products Corp.

The tube electrically is quite similar to the standard 201-A type. It is equipped with a four-prong UX base, which will also fit sockets of the shell or UV type.



The wiring diagram of the seven-tube, one-dial receiver. The switching jack, which throws in either two or three stages of audio amplification, has been omitted for the sake of clarity.

SUCCESSFUL ONE-DIAL TUNING IN SEVEN-TUBE SET

SUCCESSFUL one-dial tuning is accomplished in a new seven-tube receiver by means of a well-designed condenser coupling arrangement and with the aid of an antenna circuit of somewhat unusual nature. There are four tubes (including the detector) in the radio-frequency section of the set, but there are only three tuned circuits, adjusted simultaneously to resonance by three separate variable condensers belted together to turn as one. The aerial circuit and the appended grid circuit of the first tube are not tuned by any of the usual means, the two being coupled merely by a small R.F. choke coil which permits them to respond to all the frequencies in the broadcast band.

This removal of the antenna circuit as a tuning problem enables the manufacturer of the receiver to fix the constants of the interstage units, and to couple together the three tuning condensers with the assurance that the latter will tune accurately over the broadcast band without requiring constant readjustment. For extremely fine tuning the instruments may be adjusted individually, but they are so carefully matched that for all practical purposes the large tuning knob is the sole "station finder" which the set owner need manipulate.

The accompanying diagram and illustrations reveal the overall construction of the receiver, which was tested in the RADIO NEWS laboratories and found to be sensitive, sharp, loud and clear. It operated as a true one-dial set, no sub-adjustments on the vernier knobs (V) being found necessary.

As can be seen, the set incorporates three stages of R.F. amplification (with only two of the tuned type), a non-regenerative detector, one stage of resistance-capacity-coupled and two stages of transformer-coupled A.F. amplification. A rheostat connected to the R.F. tube filaments acts as an effective volume control. The coupling between the primary and secondary of the first interstage transformer (between the first and second tubes) is variable; manual adjustment of the position of the primary in regard to the secondary being allowed by the knob S on the front panel. This feature permits the set owner to adjust the selectivity of the receiver to meet his own local conditions. A switching jack (J) controls the audio amplifier, cutting in either one or two of the transformer stages. This switch is not shown in the schematic diagram, as its complicated connections would be confusing; its purpose is obvious.

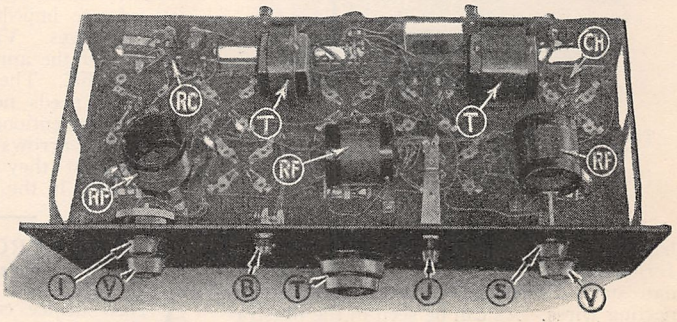
All the working parts of the receiver are carried on a rigid, pressed-steel framework; the front panel, of decorated brass, carrying the weight of only the rheostat, the switches and the selectivity knob. This framework gives the set great mechanical strength, protecting the electrical components from displacement and injury. It also acts as an electrical shield for the entire circuit.

The tube sockets, radio-frequency and audio-frequency transformers and the automatic filament resistors are supported on a bakelite sub-panel fastened in a horizontal position to the steel chassis. Most of the parts can be recognized without trouble. In the front view of the set, T is the main tuning knob, the double pointer of which travels over scales graduated directly in meters and from 0 to 100. The two smaller knobs, V, are attached to the shafts of the end variable condensers, and by means of an ingenious slipping clutch mechanism, permit the condensers to be turned independently of the main knob, T. The lower left-hand knob S is the selectivity control, turning the primary of the first R.F. coupler. The right-hand knob I is the R.F. filament rheostat, or volume control. The battery on-off switch is B, the audio amplifier switch, J.

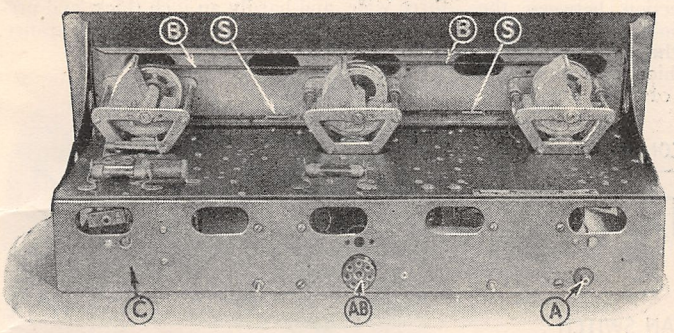
The cabinet is of mahogany, 22 inches long, 10¼ inches high and 10¼ inches deep.

In the back view, C is the steel chassis, AB the battery connector plug, A a separate little plug for the aerial wire, B-B the condenser driving belts and S-S the small springs that keep the latter taut. A complete drawing giving the details of this interesting condenser coupling scheme is also shown.

In the under view, the front panel markings are the same as before. The letters RF indicate the radio-frequency transformers, T the audio transformers, RC the resistance-capacity elements and CH the little choke coil in the aerial circuit. The R.F. transformer at the extreme right is that equipped with the variable primary. It is similar to the 180-degree vario-couplers which were quite popular a few years ago.

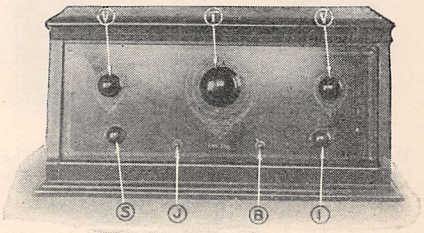


Right: Under view of the receiver chassis, showing the disposition of the various R.F. and A.F. components. The socket springs are fastened directly to the bakelite sub-panel.



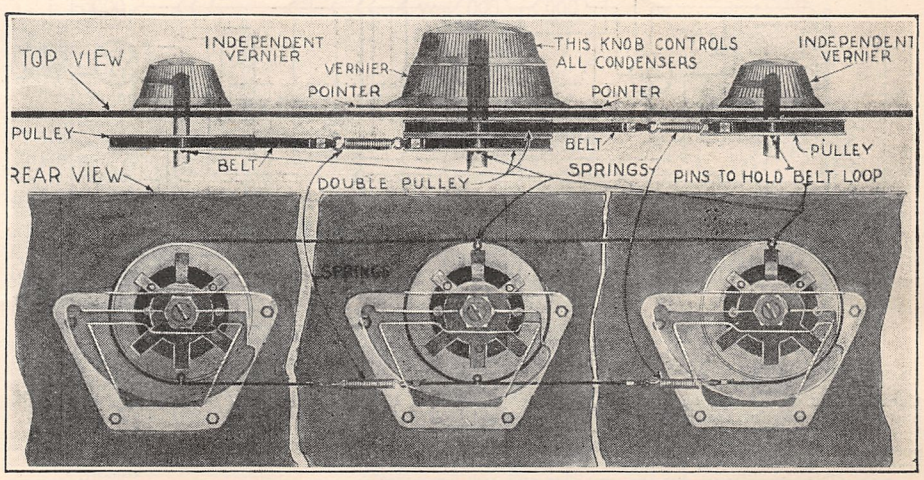
Left: Back view of the set, showing how the three condensers are belted together. The small springs S keep the belts taut.

Illustrations on this page courtesy Day-Fan Electric Company.



Front view of the receiver, showing the panel controls.

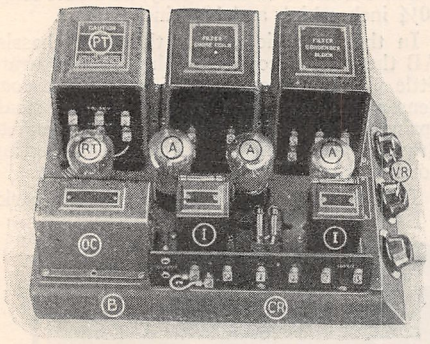
With a receiver of this type, of course, one of the prime requisites is an antenna of the best construction and proper length. The length should be between 75 and 100 feet, including the wire from the antenna proper to the receiving set.



The details of the condenser coupling mechanism are clearly shown in this drawing.

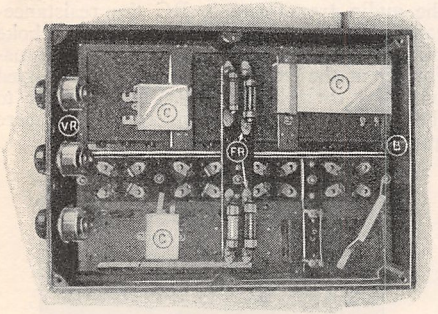
NEW UNIT COMBINES AUDIO AMPLIFIER AND "B" SUPPLY

A COMBINED audio amplifier and "B" power supply unit of advanced electrical and mechanical design has recently been brought out by a New England manufacturer. It is a complete audio amplifier, and can be attached to any radio tuner to form a receiver of volume and unsurpassed tonal quality. It is available in two forms: assembled and unwired, and assembled and all wired for use.



The combined amplifier—"B" power unit with the rectifier and amplifier tubes in place.
Illustrations courtesy the National Company.

The unit consists of a heavy cast-iron base (B) 14 inches long and 10 inches wide, formed with a shallow bottom to accommodate small condensers, resistors, and the connecting wires. As can be seen in the illustrations, its top surface holds a high-and-low voltage power transformer, PT, at the left



Under view of the amplifier-power unit. The instrument is shown unwired, but with all the parts in place.

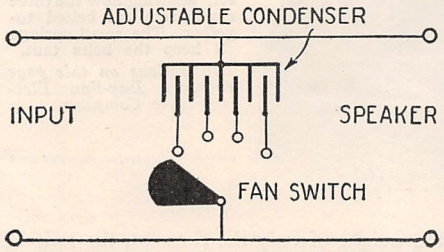
rear, and two similar cans containing filter choke coils and filter condensers, respectively. In front of these three instruments, and along the approximate center line of the base, there is a row of four tube sockets built into a bakelite strip. These receptacles take a Raytheon rectifier tube, RT, and three high-mu amplifier tubes, A.

In the foreground there is an output filter unit (OC) consisting of a choke coil and a fixed condenser, and two impedance-resistance units I-I. Between the latter there is a double resistor mounting, and in front of them a small connection rack, CR. Along the beveled right-hand edge are three variable resistors to control the output voltages. The under view of the base (B) shows the instruments before they have been wired. The letters C indicate fixed condensers, VR, the variable resistors again.

The complete circuit of the combined amplifier-power unit is given as a matter of interest to radio constructors. The "motorboating" trouble so common to resistance-coupled amplifiers operating on "B" substitutes is entirely overcome in this instrument by the use of an impedance instead of a resistor in the grid circuit of the last tube. Thus it can be seen that the amplifier consists of one impedance and two resistance-coupled stages. Vagrant R.F. currents are kept out of the amplifier by the R.F. choke, marked RFC. The rest of the circuit is obvious and needs no explanation. It might merely be mentioned that the three resistances, with arrows drawn through them to indicate that they are variable, are those marked VR in the photographs.

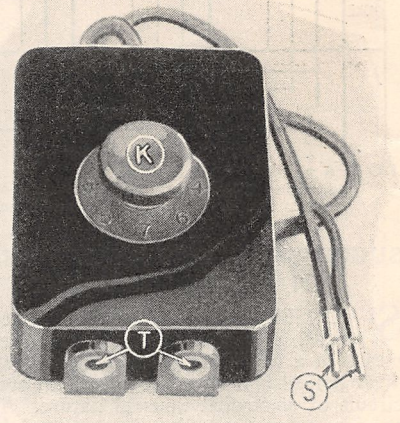
"TONE CONTROL" MATCHES LOUD SPEAKER AND AMPLIFIER

A New device called a "tone control" is designed for connection between the speaker and the last audio-amplifier tube of a receiver and assists in the matching of the two units in such a fashion that the most satisfactory reproduction of voice and music



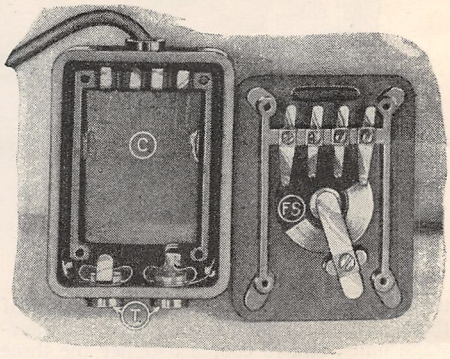
Wiring diagram of the tone control. It can be seen that the adjustable condenser simply shunts the loud-speaker circuit.

is obtained. The instrument compensates in great part for the differences in impedance between the speaker and the plate circuit of the tube and causes a marked change in the tonal aspects of the signals. It cannot overcome inherent deficiencies in either the amplifier system or in the loud speaker, but in many sets it is capable of improving the tone quality to suit the ear of the listener.



The tone control. K is the adjusting knob. The tips S go to the output of the set, while the tip jacks T take the loud-speaker cord.

The device consists of a condenser with a maximum capacity of .035-mf., tapped in four places and equipped with a fan switch which allows easy adjustment. It simply parallels the loud-speaker circuit, as shown in the accompanying diagram. It occupies little room, being only about four inches long, three wide, and hardly an inch thick, and presents a pleasing and unobtrus ive appearance.



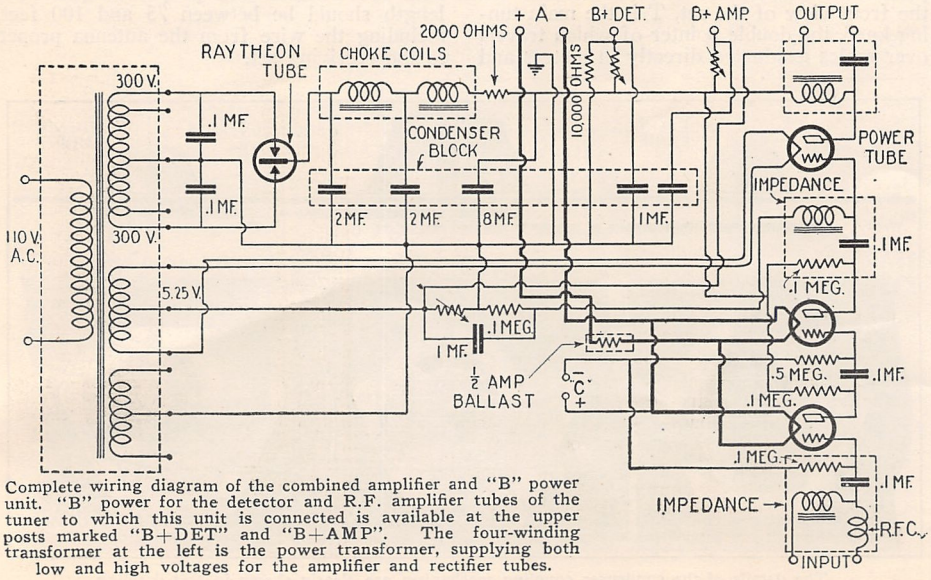
Inside view of the tone control. C is the tapped fixed condenser, T the tip jacks, FS the fan switch.
Illustrations courtesy the Sprague Specialties Company.

UNUSUAL CONSTRUCTION IN GERMAN DETECTOR

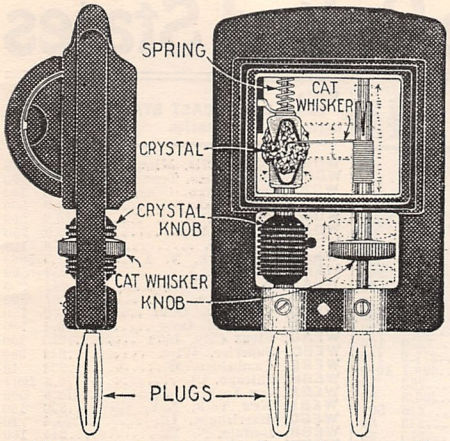
THE serious attention which crystal detectors receive in Europe is exemplified in an unusual detector sent to RADIO NEWS by a German manufacturer. The instrument embodies refinements in construction which undoubtedly would have been considered superfluous in the United States even when crystals were at the height of their popularity, but which make a description of it of interest to radio fans.

The detector consists of a molded composition body, formed as shown in the illustration. It stands upright, being equipped with two plugs which fit into a pair of receptacles fastened, usually, to the top of a receiver cabinet. The crystal itself is held between two small jagged jaws, of which one is under the pressure of a spring and the other terminates in a small knurled control knob. The catwhisker wire is coiled around a small piece of brass tubing, which slides over a rod fixed in the composition body, as shown. The entire surface of the crystal can be probed with the aid of the catwhisker and crystal control knobs.

The crystal and the catwhisker are viewed



Complete wiring diagram of the combined amplifier and "B" power unit. "B" power for the detector and R.F. amplifier tubes of the tuner to which this unit is connected is available at the upper posts marked "B+DET" and "B+AMP". The four-winding transformer at the left is the power transformer, supplying both low and high voltages for the amplifier and rectifier tubes.



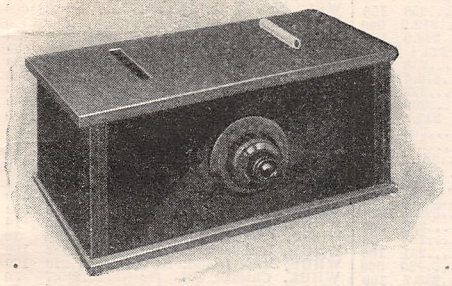
Side and front views of the enclosed crystal detector.

Illustration courtesy Ideal Radiotelefon & Apparatefabrik, Berlin.

through a small celluloid window of semi-cylindrical shape. The instrument is about 2½ inches high, 2 inches wide and 1 inch thick across the upper window section.

RADIO CIGARETTE BOX

A FLORIDA constructor has made a novelty in the form of a "radio cigarette box." In outward appearance the box resembles a small one-dial radio receiver, but its inside contains cigarettes instead of tuning coils and condensers. When the dial is turned in either direction a cigarette is delivered through a slot at the top of the cabinet. Space is provided for a sheet of dampened blotting paper, which makes the box an efficient humidor.

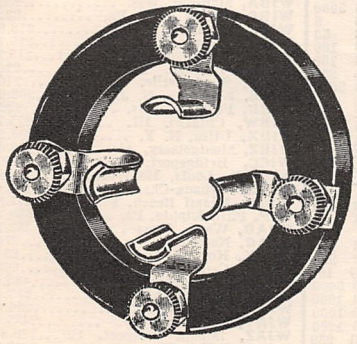


The "radio cigarette" box. A cigarette has been delivered at the right-hand slot. Another can be obtained at the left-hand opening if the dial is turned in that direction.

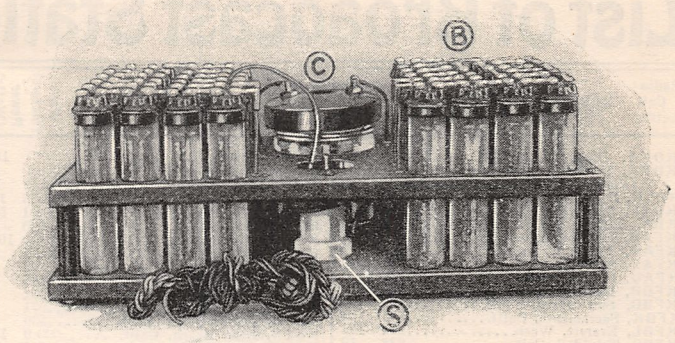
Illustration courtesy Herbert C. McKay.

A SIMPLE VACUUM-TUBE SOCKET

IT is claimed that capacity inherent in a tube socket is considerably reduced from the usual amount in the case of this one. The four metal contacts make excellent connection with the prongs of the tube, this arrangement being more or less similar to the prong-and-socket idea which was brought out some time ago in this country.



The simple construction of the tube socket is obvious.



The 100-volt storage "B" battery, with the protecting case removed to show the cells and charger.

Illustration courtesy the Grayine Corporation.

STORAGE "B" BATTERY

A new storage "B" battery unit contains a built-in electrolytic charger designed specifically for it. The inclusion of the charger makes the unit a convenient one and permits the owner of the battery to keep it in good condition at all times. This feature will appeal to people who prefer the storage "B" battery to other forms of plate supply, but who often find the problem of charging a vexing one.

In the illustration the battery cells are marked B, the charger C. The letter S indicates a lamp socket. This accommodates an ordinary electric lamp, which acts as a regulating resistance in the charging circuit.

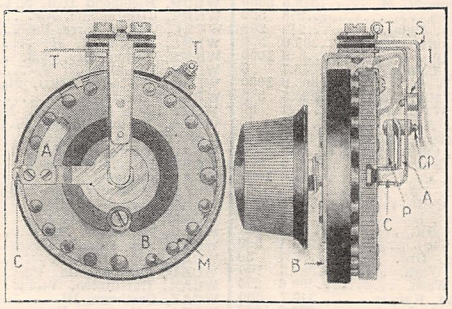
The battery consists of 48 cells, and develops 100 volts. It is enclosed in a brown crystalline-finish case, and stands 16½ inches long, 8½ inches wide and 7 inches high.

ARM OF RHEOSTAT CONTROLS FILAMENT SWITCH

A SWITCH is built directly upon the frame of a new rheostat in such a manner that, when the rheostat itself is in the "off" position, the switch likewise is open, and keeps the entire filament circuit open. Thus, automatic filament controls may be used on the detector and audio amplifier tubes of a receiver while the rheostat is used as a volume control on the radio-frequency tubes, with the knob of the instrument acting as the switch for the entire set. A separate switch on the set panel is unnecessary.

The construction of the rheostat is evident from the accompanying drawings. To the contact end C of the rotating arm is fastened an auxiliary arm, A. When the knob is turned around to take C beyond the end of the resistance element, the arm A presses against the end of a short insulating bar I, causing the outer spring S to move away from the contact point CP and thereby open the switch.

The letters T indicate soldering lugs. The molded bakelite base is B. The circular resistance element is stretched around a series of little upright mounts M, which provide free ventilation. P is a pig-tail connection to the turning arm.

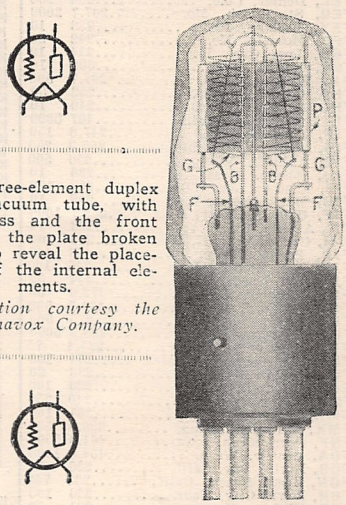


The phantom lines show the position of the rotating member (C-A) in the "off" position.

Illustration courtesy Yaxley Mfg. Co.

DUPLEX GRID IN NEW TUBE

IN a new three-element vacuum tube intended for use as amplifier, detector or oscillator, the grid element takes the form of two separate little meshes (G and G) spot-welded to a stiff U-shaped piece of supporting wire (B and B) in the manner indicated in the accompanying drawing. The filament is likewise split into two sections, each of which passes through a section of the grid.



The three-element duplex grid vacuum tube, with the glass and the front side of the plate broken away to reveal the placement of the internal elements.

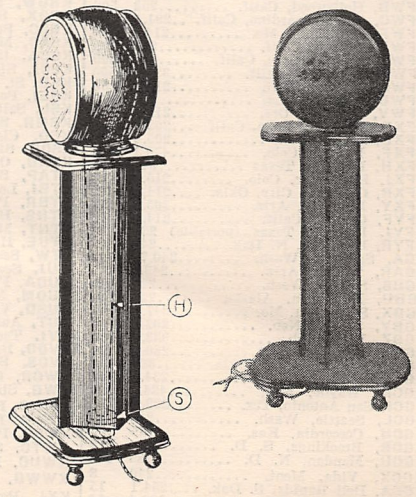
Illustration courtesy the Magnavox Company.

In the illustration the wires in which the ends of the filament terminate are marked F and F. The plate is marked P.

The electrical characteristics of this tube closely approximate those of the standard 201-A type. It is rated at 5 volts and ¼ ampere for the filament and between 22½ and 90 volts for the plate.

UPRIGHT LOUD SPEAKER

AT first glance this loud speaker appears to be a cone upon a movable stand, but further examination reveals that the drum-like head covers the bell of a long horn which extends down to the base of the affair. As can be seen in the accompanying phantom illustration of the speaker, the loud-speaking unit, S, is attached to the small end of the horn, H, being hidden completely from view.



These illustrations show the construction and appearance of the upright loud speaker.

Illustrations courtesy Gemco Mfg. Co.

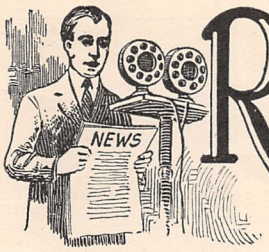
List of Broadcast Stations in the United States

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
KDKA,	!East Pittsburgh, Pa.	*309.1	Var.
KDKA,	!E. Pittsburgh, Pa.	*63.6	Var.
	(Various short-wave transmissions)		
KDLR,	Devils Lake, N. D.	231	5
KDYL,	Salt Lake City, Utah	246.8	250
KEX,	Portland, Ore.	447	1000
KFAB,	Lincoln, Neb.	*340.7	5000
KFAD,	Phoenix, Ariz.	272.6	500
KFAF,	San Jose, Calif.	217.3	50
KFAU,	Boise, Idaho	280.2	2000
KFBB,	Havre, Mont.	275	50
KFBC,	San Diego, Calif.	280	100
KFBK,	Sacramento, Calif.	535	100
KFBL,	Everett, Wash.	224	100
KFBS,	Trinidad, Colo.	238	15
KFBU,	Laramie, Wyo.	375	500
KFCB,	Phoenix, Ariz.	238	125
KFCR,	Santa Barbara, Calif.	413	15
KFDD,	Boise, Idaho	275.1	50
KFDM,	Beaumont, Tex.	315.6	500
KFDX,	Shreveport, La.	236.1	100
KFDY,	Brookings, S. Dak.	299.8	1000
KFDZ,	Minneapolis, Minn.	231	10
KFEC,	Portland, Ore.	252	150
KFEL,	Denver, Colo.	254	250
KFEQ,	St. Joseph, Mo.	267.7	2000
KFEY,	Kellogg, Idaho	233	10
KFFP,	Mcberly, Mo.	242	50
KFGB,	Iowa City, Ia.	224	10
KFGQ,	Boone, Iowa	300	10
KFH,	Wichita, Kans.	*267.7	500
KFHA,	Gunnison, Colo.	252	50
KFHL,	Oskaloosa, Iowa	240	10
KFI,	Los Angeles, Calif.	467	5000
KFIF,	Portland, Ore.	247.8	150
KFIO,	Spokane, Washington	265.3	250
KFIQ,	Yakima, Wash.	256	500
KFIU,	Juneau, Alaska	226	10
KFIZ,	Fond du Lac, Wis.	273	100
KFJB,	Marshalltown, Iowa	248	10
KFJF,	Oklahoma City, Okla.	260.7	1000
KFJI,	Astoria, Ore.	246	10
KFJM,	Grand Forks, N. Dak.	278	100
KFJR,	Portland, Ore.	263	120
KFJY,	Fort Dodge, Iowa	246	100
KFJZ,	Fort Worth, Tex.	254	50
KFKA,	Greeley, Colo.	*272.6	50
KFKB,	Milford, Kas.	434.5	500
KFKU,	Lawrence, Kans.	275	500
KFKX,	Hastings, Nebr.	288.3	5000
KFKZ,	Kirksville, Mo.	225.4	75
KFLR,	Albuquerque, N. Mex.	254	100
KFLU,	San Benito, Tex.	236	20
KFLV,	Rockford, Ill.	229	100
KFLX,	Galveston, Tex.	240	250
KFMR,	Sioux City, Iowa	261	100
KFMX,	Northfield, Minn.	336.9	500
KFNF,	Shenandoah, Iowa	461.3	2500
KFOA,	Seattle, Wash.	454.3	1000
KFOB,	Burlingame, Calif.	226	50
KFON,	Long Beach, Calif.	233	750
KFOR,	David City, Nebr.	226	100
KFOT,	Wichita, Kans.	231	50
KFOX,	Omaha, Nebr.	248	100
KFOY,	St. Paul, Minn.	252	50
KFPL,	Dublin, Texas	252	20
KFPM,	Greenville, Texas	242	10
KFPR,	Los Angeles, Calif.	230.6	500
KFPW,	Carterville, Mo.	258	20
KFPY,	Spokane, Wash.	273	100
KFQA,	St. Louis, Mo.	280.2	5000
KFQB,	Fort Worth, Texas	508.2	2500
KFQD,	Anchorage, Alaska	227.1	100
KFQU,	Alma (Holy City) Calif.	231	250
KFQW,	Seattle, Wash.	215.7	50
KFQX,	Seattle, Wash.	210	15
KFQZ,	Hollywood, Calif.	225.4	500
KFRB,	Beeville, Tex.	248	250
KFRC,	San Francisco, Calif.	267.7	50
KFRU,	Columbia, Mo.	*499.7	500
KFSD,	San Diego, Calif.	245.8	1000
KFSG,	Los Angeles, Calif.	275	500
KFUL,	Galveston, Tex.	258	500
KFUM,	Colorado Springs, Colo.	239.9	100
KFUO,	St. Louis, Mo.	545.1	500
KFUP,	Denver, Colo.	234	50
KFUR,	Ogden, Utah	224	50
KFUS,	Oakland, Calif.	256	50
KFUT,	Salt Lake City, Utah	263	100
KFVD,	Venice, Calif.	208	500
KFVE,	St. Louis, Mo.	240	5000
KFVG,	Independence, Kas.	236	15
KFVI,	Houston, Texas	239.9	50
KFVN,	Fairmont, Minn.	227	50
KFVR,	Denver, Colo.	244	50
KFVS,	Cape-Girardeau, Mo.	*223.7	50
KFVY,	Albuquerque, N. Mex.	250	10
KFWB,	Hollywood, Calif.	252	500
KFWC,	San Bernardino, Calif.	291.1	200
KFWF,	St. Louis, Mo.	214.2	500
KFWH,	Eureka, Calif.	254	100
KFWI,	San Francisco, Calif.	250	500
KFWM,	Oakland, Calif.	325.9	500
KFWO,	Avalon, Calif.	211.1	250
KFWU,	Pineville, La.	238	100
KFWV,	Portland, Ore.	212.6	50
KFXB,	Big Bear Lake, Calif.	202.6	500
KFXD,	Logan, Utah	205.4	10
KFXF,	Denver, Colo.	430.1	1000
KFXH,	El Paso, Texas	242	50
KFXJ,	Edgewater, Colo.	215.7	15
KFXR,	Oklahoma City, Okla.	214.2	15
KFXY,	Flagstaff, Ariz.	205.4	50
KFYF,	Oxnard, Calif.	214.2	10
KFYJ,	Houston, Texas (portable)	238	10
KFYR,	Bismarck, N. Dak.	248	10
KGA,	Spokane, Wash.	340.7	20000
KGAR,	Tucson, Ariz.	243.8	100
KGBS,	Seattle, Wash.	227	100
KGBU,	Ketchikan, Alaska	229	500
KGBX,	St. Joseph, Mo.	347.8	50
KGBY,	Shelby, Neb.	202.6	50
KGBZ,	York, Neb.	333.1	100
KGCA,	Decorah, Ia.	280.2	20
KGCB,	Oklahoma City, Okla.	331	100
KGCG,	Newark, Ark.	234.2	100
KGCH,	Wayne, Neb.	434.5	500
KGCI,	San Antonio, Tex.	239.9	15
KGCL,	Seattle, Wash.	238	10
KGCN,	Corcordia, Kas.	235	50
KGCR,	Brookings, S. D.	252	10
KGCU,	Mandan, N. D.	285	100
KGCX,	Vida, Mont.	240	8
KGCA,	Dell Rapids, S. Dak.	254.1	15
KGDE,	Barrett, Minn.	232.4	50
KGDJ,	Cresco, Iowa	214.2	8
KGDM,	Stockton, Calif.	217.3	5
KGDO,	Dallas, Tex.	285	100
KGDP,	Pueblo, Colo.	260.7	10
KGDR,	San Antonio, Tex.	240	15
KGDW,	Humboldt, Neb.	241.8	100
KGDX,	Shreveport, La.	291.1	500
KGDY,	Oldham, S. D.	210	15
KGEF,	Los Angeles, Calif.	516.9	1000
KGEH,	Eugene, Ore.	236.1	50
KGEK,	Yuma, Colo.	252	10
KGEL,	Jamestown, N. D.	225	50
KGEN,	El Centra, Calif.	281	15
KGEO,	Grand Island, Neb.	271	50
KGEQ,	Minneapolis, Minn.	330	50
KGER,	Long Beach, Calif.	325.9	100
KGES,	Central City, Neb.	205.4	10
KGEU,	Lower Lake, Calif.	222	50
KGEW,	Fort Morgan, Colo.	256	10
KGEX,	Muscatine, Iowa	256	100
KGEY,	Denver, Colo.	204	15
KGEZ,	Kalispell, Mont.	352	100
KGFA,	Seattle, Wash.	305.9	1000
KGFF,	Alva, Okla.	205.4	25
KGFG,	Oklahoma City, Ok.	384	50
KGFH,	La Crescenta, Calif.	218.8	100
KGFI,	Fort Stockton, Tex.	220.4	15
KGFJ,	Los Angeles, Calif.	218	100
KGO,	Oakland, Calif.	*361.2	5000
KGRC,	San Antonio, Tex.	315	50
KGRS,	Amarillo, Tex.	234.2	100
KGTT,	San Francisco, Calif.	206.8	50
KGU,	Honolulu, Hawaii	270	500
KGW,	Portland, Ore.	491.5	1000
KGY,	Lacey, Wash.	278.8	50
KHJ,	Los Angeles, Calif.	405.2	500
KHQ,	Spokane, Wash.	394.5	1000
KHX,	Los Angeles, Calif. (port.)	119.9	500
KICK,	Anita, Ia.	273	100
KJBS,	San Francisco, Calif.	220.4	5
KJR,	Seattle, Wash.	384.4	20000
KKP,	Seattle, Wash.	260	15
KLDS,	Independence, Mo.	*440.9	1000
KLS,	Oakland, Calif.	250	250
KLX,	Oakland, Calif.	508.2	500
KLZ,	Denver, Colo.	384.4	500
KMA,	Shenandoah, Iowa	461	500
KMED,	Medford, Ore.	250	50
KMIC,	Inglewood, Cal.	387	500
KMJ,	Fresno, Calif.	234	50
KMJP,	Kansas City, Mo.	410.9	1000
KMMJ,	Clay Center, Neb.	228.9	1000
KMO,	Tacoma, Wash.	250	500
KMOX,	!Kirkwood, (St.Lo.) Mo.	280.2	5000
KMTR,	Hollywood, Calif.	370.2	500
KNRC,	Santa Monica, Calif.	238	1000
KNX,	Los Angeles, Calif.	336.9	1000
KOA,	Denver, Colo.	*322.4	5000
KOAC,	Corvallis, Ore.	280.2	500
KOB,	State College, N. M.	348.6	5000
KOCH,	Omaha, Neb.	258	500
KOCW,	Chickasha, Okla.	252	200
KOIL,	Council Bluffs, Iowa	305.9	500
KOIN,	!Sylvan, Ore.	319	1000
KOLO,	Durango, Colo	355.1	5
KOMO,	Seattle, Wash.	305.9	1000
KOWW,	Walla Walla, Wash.	285.5	500
KPCB,	Seattle, Wash.	521	50
KPJM,	Prescott, Ariz.	215	15
KPO,	San Francisco, Calif.	*428.3	1000
KPPC,	Pasadena, Calif.	229	50
KPRC,	Houston, Texas	296.9	500
KPSN,	Pasadena, Calif.	315.6	1000
KQV,	Pittsburgh, Pa.	409	500
KQW,	San Jose, Calif.	333.1	500
KRAC,	Shreveport, La.	220	50
KRE,	Berkeley, Calif.	256	100
KRLD,	Dallas, Tex.	357.1	500
KROW,	Portland, Ore.	231	50
KROX,	Seattle, Wash.	265.3	100
KRSC,	Seattle, Wash.	499.6	250
KSAC,	Manhattan, Kansas	340.7	500
KSBA,	!Shreveport, La.	260.7	1000
KSCJ,	Sioux City, Ia.	444	10
KSD,	St. Louis, Mo.	545.1	500
KSEI,	Pocatello, Ida.	260.7	500
KSL,	Salt Lake City, Utah	299.8	1000
KSMR,	Santa Maria, Calif.	282.8	100
KSO,	Clarinda, Iowa	405.2	500
KSOO,	Sioux Falls, S. D.	360	100
KTAB,	Oakland, Calif.	302.8	1000
KTAP,	San Antonio, Tex.	263	10
KTBI,	Los Angeles, Calif.	293.9	750
KTBR,	Portland, Ore.	263	50
KTHS,	Hot Springs, Ark.	*374.8	750
KTNT,	Muscatine, Iowa	333.1	1000
KTUE,	Houston, Tex.	263	5
KTW,	Seattle, Wash.	454.3	1500
KUJ,	Seattle, Wash.	352.5	15
KUOA,	Fayetteville, Ark.	299.8	750
KUOM,	Missoula, Mont.	244	250
KUSD,	Vermillion, S. D.	278	500
KUT,	Austin, Texas	231	500
KVI,	Tacoma, Wash.	342.5	15
KVOO,	Bristow, Okla.	374.8	1000
KVOS,	Seattle, Wash.	333.1	500
KWCR,	Cedar Rapids, Iowa	296	500
KWG,	Stockton, Calif.	248	50
KWKC,	Kansas City, Mo.	236	100
KWLC,	Decorah, Iowa	431	50
KWSC,	Pullman, Wash.	348.6	500
KWTC,	Santa Ana, Calif.	263	5
KWUC,	Le Mars, Iowa	252	1500
KWWG,	Brownsville, Texas	278	750
KXL,	Portland, Ore.	400	50
KYA,	San Francisco, Calif.	399.8	1000
KYW,	Chicago, Ill.	535.4	3500
KZIB,	Manila, P. I.	249.9	20
KZKZ,	Manila, P. I.	270	100
KZM,	Oakland, Calif.	240	100
KZRQ,	Manila, P. I.	400	500
NAA,	Arlington, Va.	*454.5	1000
WAAD,	Cincinnati, Ohio	258	25
WAAF,	Chicago, Ill.	278	500
WAAM,	Newark, N. J.	*263	500
WAAT,	Jersey City, N. J.	235	500
WAAW,	Omaha, Neb.	384.4 & 278	500
WABB,	Harrisburg, Pa.	204	10
WABC,	Richmond Hill, N. Y.	315.6	500
WABF,	Kingston, Pa.	410.7	500
WABI,	Bangor, Me.	240	100
WABO,	Rochester, N. Y.	277.6	100
WABQ,	Philadelphia, Pa.	260.7	1000
WABR,	Toledo, Ohio	263	50
WABW,	Wooster, Ohio	266.8	50
WABX,	!Mount Clemens, Mich.	246	500
WABY,	Philadelphia, Pa.	242	50
WABZ,	New Orleans, La.	275	50
WADC,	Akron, Ohio	258	500
WAFD,	Detroit, Mich.	512.3	500
WAGM,	Royal Oak, Mich.	225.5	50
WAGS,	Somerville, Mass	250	5
WAIT,	Taunton, Mass.	229	10
WAIU,	Columbus, Ohio	293.9	5000
WAMD,	Minneapolis, Minn.	244	5000
WAOK,	Ozone Park, N.Y.	247.8	100
WAPI,	Auburn, Ala.	461.3	1000
WARC,	Medford Hillside, Mass.	261	100
WARS,	!Brooklyn, N. Y.	295	500
WASH,	Grand Rapids, Mich.	256.4	500
WASN,	Boston, Mass.	280	
WATT,	Boston, Mass. (portable	243.8	100
WBAA,	West Lafayette, Ind.	*272.6	500
WBAK,	Harrisburg, Pa.	275	500
WBAL,	!Glen Morris, Md.	246	5000
WBAO,	Decatur, Ill.	270	100
WBAP,	Fort Worth, Texas	475.9	1500
WBAW,	Nashville, Tenn.	236.1	100
WBAX,	Wilkes-Barre, Pa.	256	100
WBBC,	Brooklyn, N.Y.	219.9	500
WBBL,	Richmond, Va.	228.9	100
WBBM,	Chicago, Ill.	*225.4	10000
WBBP,	Petoskey, Mich.	238	200
WBBR,	Rossville, N. Y.	416.4	500
WBBW,	Norfolk, Va.	222	50
WBBY,	Charleston, S. C.	268	100
WBBZ,	Chicago, Ill. (portable)	215.7	50
WBCN,	Chicago, Ill.	266	500
WBES,	Takoma Park, Md.	222	100
WBET,	Boston, Mass.	384.4	100
WBKN,	Brooklyn, N. Y.	291.1	100
WBMC,	Woodside, N. Y.	293.9	500
WBMH,	Detroit, Mich.	352.7	100
WBNY,	New York, N. Y.	322.4	1000
WBOQ,	Richmond Hill, N.Y.	236	500
WBRC,	Birmingham, Ala.	248	50
WBRE,	Wilkes-Barre, Pa.	231	100
WBRL,	Tilton, N. H.	420	500
WBMS,	Union City, N.J.	233.7	100
WBRS,	Brooklyn, N. Y.	394	100
WBSO,	Wellesley Hills, Mass.	242	100
WBT,	Charlotte, N. C.	275	250
WBZ,	!East Springfield, Mass	*331.1	5000
WBZA,	Boston, Mass.	*331.1	250
WCAC,	Storrs, Conn.	275	500
WCAD,	Canton, N.Y.	*263	500
WCAE,	Pittsburgh, Pa.	461.3	500
WCAH,	Columbus, O.	265.3	500
WCAJ,	University Place, Neb.	254	500
WCAL,	Northfield, Minn.	336.9	500
WCAM,	Camden, N. J.	336.9	1000
WCAO,	Baltimore, Md.	275	100
WCAR,	San Antonio, Texas	263	5000
WCAT,	Rapid City, S. D.	240	50
WCAU,	Philadelphia, Pa.	277.6	500
WCAX,	Burlington, Vt.	252	100
WCAZ,	Carthage, Ill.	245.8	50
WCBA,	Allentown, Pa.	254	125
WCBD,	Zion, Ill.	344.6	5000
WCBE,	New Orleans, La.	263	5
WCBH,	University, Miss.	242	50
WCBM,	Baltimore, Md.	229	100
WCBR,	Providence, R.I. (port.)	234	100
WCBS,	Providence, R.I. (port.)	242.5	250
WCCO,	Minn.-St. Paul, Minn.	*416.4	5000
WCFL,	Chicago, Ill.	491.5	500
WCFT,	Tullahoma, Tenn.	252	10
WCGU,	Lakewood, N. J.	350.6	500
WCLO,	Camp Lake, Wis.	231	50
WCLS,	Joliet, Ill.	214.2	150
WCMA,	Culver, Ind.	258.5	500
WCOA,	Pensacola, Fla.	252	500
WCOM,	Manchester, N.H.	252	100
WCOT,	Olneyville, R.I.	265.3	1000
WCRW,	Chicago, Ill.	416.4	50
WCSH,	Portland, Me.	499.7	500
WCSO,	Springfield, Ohio	248	100
WCWK,	Fort Wayne, Ind.	234.2	250
WCWS,	Waterbury, Conn.	235	100
WCX,	!Pontiac, Mich	516.9	5000
WDAD,	Nashville, Tenn.	225.4	1000
WDAE,	Tampa, Fla.	273	1000
WDAF,	Kansas City, Mo.	365.6	1000
WDAG,	Amarillo, Texas	263	250
WDAH,	El Paso, Texas	267.7	100
WDAY,	Fargo, N.D.	261	500
WDBE,	Atlanta, Ga.	270	100
WDBJ,	Roanoke, Va.	229	50
WDBK,	Cleveland, Ohio	227	500
WDBO,	Winter Park, Fla.	240	500
WDBZ,	Kingston, N. Y.	232.4	10
WDEL,	Wilmington, Del.	266	100
WDGY,	Minneapolis, Minn.	263	500
WDOD,	Chattanooga, Tenn.	256	500
WDRC,	New Haven, Conn.	268	100
WDWF,	Edgewood, R.I.	440.9	500
WDWM,	Newark, N. J.	280.2	500
WDXL,	Detroit, Mich.	296.9	250
WDZ,	Tuscola, Ill.	278	100
WEAF,	New York, N. Y.	*491.5	5000
WEAI,	Ithaca, N. Y.	254	500
WEAM,	North Plainfield, N. J.	261	250
WEAN,	Providence, R. I.	367	500
WEAO,	Columbus, Ohio	*293.9	750
WEAR,	Cleveland, Ohio	*389.4	750
WEAU,	Sioux City, Iowa	275	150
WEBC,	Superior, Wisc.	242	300
WEBE,	Cambridge, O.	234	10
WEBH,	Chicago, Ill.	370.2	2000
WEBJ,	New York, N. Y.	272.6	500
WEBL,	New York, N.Y. (port.)	226	100
WEBQ,	Harrisburg, Ill.	*225.4	10
WEBR,	Buffalo, N. Y.	244	100
WEBW,	Beloit, Wis.	267.7	700
WEDC,	Chicago, Ill.	249.9	1000
WEEI,	Boston, Mass.	348.6	500
WEHS,	Evanston, Ill.	241.8	100
WEMC,	Berrien Springs, Mich.	315.6	4000
WENR,	Chicago, Ill.	*265.3	1000
WEPS,	Gloucester, Mass.	295	100
WEW,	St. Louis, Mo.	360	1000
WFAA,	Dallas, Texas	475.9	500
WFAM,	St. Cloud, Minn.	273	10
WFAV,	Lincoln, Nebr.	275	500
WFBC,	Knoxville, Tenn.	250	50
WFBE,	Cincinnati, O.	292.4	500
WFBG,	Altoona, Pa.	*277.6	100
WFBJ,	Collegeville, Minn.	236	100
WFBL,	Syracuse, N.Y.	252	500
WFBM,	Indianapolis, Indiana	268	250
WFBR,	Baltimore, Md.	254	100
WFBZ,	Galesburg, Ill.	254	20
WFCI,	Pawtucket, R.I.	258.5	100
WFDF,	Flint, Mich.	234	100
WFHH,	Clearwater, Fla.	353.4	500
WFI,	Philadelphia, Pa.	394.5	500
WFIW,	Hopkinsville, Ky.	356	1000
WFKB,	Chicago, Ill.	217.3	500
WFKD,	Philadelphia, Pa.	249.9	10
WFLA,	Boca Raton, Fla.	440	1000
WFRL,	Brooklyn, N. Y.	329.5	100
WGAL,	Lancaster, Pa.	248	10
WGBB,	Freeport, N. Y.	244	100
WGBC,	Memphis, Tenn.	277.6	15
WGBF,	Evansville, Ind.	256	500
WGBI,	Scranton, Pa.	240	100
WGBR,	Marshfield, Wis.	228.9	50
WGBS,	!Astoria, N. Y.	315.6	500
WGBU,	Fulford, Fla.	384.4	500
WGBX,	Orono, Me.	234.2	500
WGCP,	Newark, N. J.	252	500
WGES,	!Oak Park, Ill.	315.6	500
WGHP,	Mt. Clemens, Mich.	270	1500
WGL,	New York, N.Y.	422.3	1000
WGM,	Jeannette, Pa.	269	150
WGMU,	Richmond Hill, N.Y. (port.)	236	100
WGN,	Elgin, Ill.	302.8	1000
WGR,	Buffalo, N. Y.	319	750
WGST,	Atlanta, Ga.	270	500
WGWB,	Milwaukee, Wis.	384.4	1000
WGY,	Schenectady, N. Y.	*379.5	50000
WHA,	Madison, Wis.	535.4	1000
WHAD,	Milwaukee, Wis.	275	500
WHAM,	Rochester, N. Y.	278	100
WHAP,	New York, N.Y.	431	1000
WHAR,	Atlantic City, N. J.	275	500
WHAS,	Louisville, Ky.	399.8	500
WHAZ,	Troy, N. Y.	379.5	500
WHB,	Kansas City, Mo.	365.6	500
WHBA,	Oil City, Pa.	250	10
WHBC,	Canton, Ohio	254	10
WHBD,	Bellefontaine, Ohio	222	100
WHBF,	Rock Island, Ill.	222	100
WHBL,	Chicago, Ill. (port.)	215.7	50
WHBM,	Chicago, Ill. (port.)	215.7	20
WHBN,	St. Petersburg, Fla.	238	10
WHBP,	Johnstown, Pa.	256	100
WHBQ,	Memphis, Tenn.	253	50
WHBR,	Cincinnati, O.	215.7	300
WHBU,	Anderson, Ind.	218.8	10
WHBW,	Philadelphia, Pa.	215.7	100
WHBY,	West De Pere, Wis.	250	50
WHDI,	Minneapolis, Minn.	278	500
WHEC,	Rochester, N. Y.	258	100
WHFC,	Chicago, Ill.	258.5	150
WHK,	Cleveland, Ohio	272.6	1000
WHN,	New York, N. Y.	361.2	1000
WHO,	Des Moines, Iowa	*526	5000
WHPP,	New York, N.Y.	297	
WHOG,	Huntington, Ind.	241.8	15
WHT,	!Deerfield, Ill.	399.8	3500
WIAD,	Philadelphia, Pa.	250	100
WIAS,	Burlington, Iowa	254	100
WIBA,	Madison, Wis.	236	100
WIBG,	Elkins Park, Pa.	222	50
WIBI,	Flushing, N. Y.	218.8	50
WIBJ,	Chicago, Ill. (port.)	215.7	50
WIBM,	Chicago, Ill. (port.)	215.7	10
WIBO,	Chicago, Ill.	226	1000
WIBR,	Steubenville, Ohio	246	50
WIBS,	Elizabeth, N. J.	202.6	10
WIBU,	Poynette, Wis.	222	20
WIBW,	Chicago, Ill.	215.7	100
WIBX,	Utica, N. Y.	234.2	150
WIBZ,	Montgomery, Ala.	230.6	10
WICC,	Bridgeport, Conn.	285	500
WIL,	St. Louis, Mo.	258	250
WILL,	Urbana-Champaign, Ill.	272.6	1000
WIOD,	Miami Beach, Fla.	247.8	1000
WIP,	Philadelphia, Pa.	508.2	500
WJAD,	Waco, Texas	*352.7	500
WJAG,	Norfolk, Nebr.	270	200
WJAK,	Kokomo, Ind.	254	50
WJAM,	Cedar Rapids, Iowa	268	100
WJAR,	Providence, R.I.	483.5	500
WJAS,	Pittsburgh, Pa.	275.1	500
WJAX,	Jacksonville, Fla.	336.9	1000
WJAY,	Cleveland, O.	435.7	1000
WJAZ,	!Mount Prospect, Ill.	329.8	10000
WJBA,	Joliet, Ill.	206.8	50
WJBB,	St. Petersburg, Fla.	254	250
WJBC,	La Salle, Ill.	234	100
WJBI,	Red Bank, N. J.	218.8	250
WJBK,	Ypsilanti, Mich.	233	10
WJBL,	Decatur, Ill.	270	500
WJBO,	New Orleans, La.	268	100

At the closing date of this magazine, the list of broadcast stations is subject to daily alterations, as regards wavelengths, power, etc. We especially request stations making changes at this time to send a notification to RADIO NEWS in order that broadcast listeners may be advised as soon as possible of the new conditions which they may expect in tuning in the stations.

*Standard or constant frequency.
!Location of transmitter only.

(Continued on page 1251)



Radio News of the Month

RADIO INTERFERENCE OUTLAWED

WHILE the rights of broadcast stations to the air are still to be determined, the city of Portland, Ore., has outlawed man-made interference by an ordinance prohibiting the operation between 7 and 11 p. m. of any electric device causing interference to reception, and taxing each such article a $1.00 license fee to pay for the inspection. Other cities are contemplating similar action.

TUBES WELL SHAKEN

AN English manufacturer of "valves" (vacuum tubes) pulled a stunt by dropping a dozen of them, in the cartons used for packing, from an airplane 600 feet up. While most of them were somewhat damaged, of course, "a new line of research was suggested by the discovery that one specimen had increased its emission 25%!"

METROPOLITAN POLICE RADIO

NEW YORK'S police stations have 105 receivers, all set to the municipal station's wavelength (WNYC—526 meters), which will be kept constantly turned on for reception. Should an emergency require police use of the system, a broadcast may be interrupted, just as by an SOS, if necessary to send out the announcement of a crime. The reception system was purchased some time ago, but is just being installed.

WRONG NUMBER!

PORT AU PRINCE sounds something like Bordeaux, France, and the Haitian station HHK announces in French. Many fans have written RADIO NEWS that they have heard Bordeaux; and this may explain to some others why they have failed to obtain verifications from the French city. Reception from HHK, which is in the West Indies, about 1,500 miles south of New York, has been very good all over the East.

EAST INDIAN RADIO

THE Dutch Colonial government has removed the restriction, hitherto preventing the ownership of radio sets and licenses their possession in the East Indies. It does not appear that transmitting is permitted.

LONGEST "WIRED WIRELESS"

THE 220,000-volt high-tension power lines of the Pacific Gas & Electric Co., over a distance of 202 miles, are now linked by carrier-current telephony. A 1,000-watt transmitter is used for the purpose, coupled to the power wires by an 1,800-foot aerial. The system is in use solely for communication between the powerhouse at Pit River, and the Vaca-Dixon substation. Special oscillating microphones are used for calling the operators.

CANADIAN WAVE CHANGES

WITH the problem of interference by the increasing number of United States stations felt beyond the border, the radio division of the Canadian government has caused a temporary interchange of wave lengths between the stations of Ottawa and Toronto. The results of the experiment have not been announced as we go to press.

NEW PHILIPPINE STATION

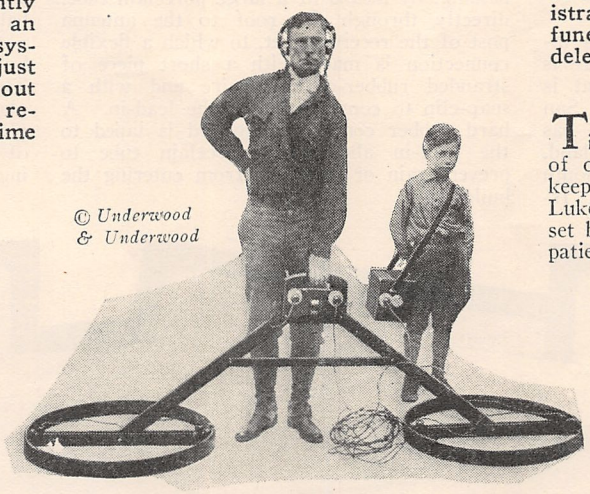
WITH an increase of power tenfold in the new transmitter at Manila Heights, P. I., it is expected that consistent reception throughout the archipelago may be expected. Fans in the United States, also, should be able to obtain DX reception of KZRQ more frequently.

NO RADIO IN SIAM

THE unrest of the awakening East is to find no echo by radio in Siam, where a royal edict forbids reception, to avoid Chinese propaganda. Many Americans will remember the country's anthem, "O Vatana Siam!"

CHEER FOR THE VETERANS

SAN DIEGO, Calif., has 548 patients in the naval hospital, to which the American Legion post has just presented two radio receivers with 6-tube power amplifiers, and a system providing each bed with head phones as well as cone speakers for the Red Cross and medical corps buildings. Local entertainment is available during the day and DX programs during the evening for the patients.—*Thomas J. Harrison.*



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HE FOUND PIRATE GOLD BY RADIO

The invention of G. O. Maher, of Baton Rouge, La., detects the presence of a mass of metal nine feet below the ground, by its effect in changing the inductance of a coil in an oscillator circuit, and consequently the pitch of an audible note.

BROADCASTING FROM CORK

IRELAND is to have its third broadcast station, the Free State having determined to establish one at Cork. As the city gaol (English for hoosegow) is fortunately untenanted, the building will be used to house the radio equipment.

(*Continued on page* 1277)

IN THE NORTH STAR STATE

THE northernmost part of the United States (except for Alaska) is (as few people know) on the Canadian shore of the Lake of the Woods. Recently the postoffice department broadcast through WCCO, in the Twin Cities, a request for the postmaster at Oak Island, Minn., to get through his quarterly report if possible. Three days later it was sent in, by dog team over the 85 miles of frozen lake.—*W. L. Lawrence.*

A RADIO GRAFTER'S SCHEME

NEW YORK has had a murderous "radio burglar," who stole receivers and sold them to "fences." Less violent in his methods is a thief who has been visiting homes in the city with the explanation that a dealer has sent him to obtain the set for repair. He then disconnects it, walks out with it boldly —and leaves no address.

STATION IN MOURNING

THE death of Mayor Edward L. Bader of Atlantic City caused the programs of the municipal broadcast station, WPG, to be put in mourning by the city administration. During the period before the funeral, the dance music numbers were deleted from the programs.

RADIO AND SURGERY

TO avoid mental shock to a patient who is undergoing an operation with the aid of only local anesthetics, it is desirable to keep his mind engaged. Surgeons in St. Luke's hospital, Chicago, now place a radio set beside the operating table and carve the patient to the accompaniment of music.

FURTHEST NORTH

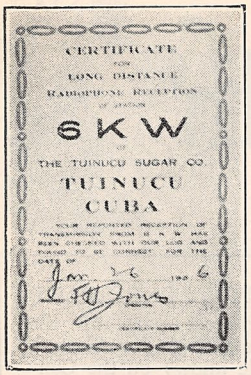
STATION OGG, at Godhaven, the capital of North Greenland, has been often heard this winter. This station, which entertains the Greenlanders during their long night, rebroadcasts from high-power stations in the United States and Canada; and is also conducting research work on the aurora. It transmits on 575 meters at 3 p. m., E. S. T.

LINKING PLANE AND HOME

NOW that radio telephony from trains is on a commercial basis, in Germany at least, the U. S. Bureau of Standards announces that it is working on a system whereby a radiophone message from an airplane may be connected up with the long-distance wires.

FAN OBTAINS $2,000 VERDICT

PETER J. WALTER, of Milwaukee, was awarded a verdict for heavy damages against the lighting and traction company, for erecting near his home a high-tension line which prevented reception on his radio set. The case has been fought through the state courts, and is now expected to go to the federal supreme court for final affirmation. The case is legally unique.

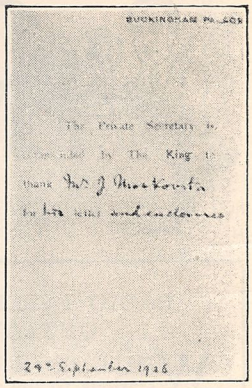


A "proof of reception" card from a Cuban station.

Super-DX Reception

San Pedro Enthusiast Receives Programs from All Continents

By HERNDON R. GREEN



The acknowledgement from King George V.'s secretary.

IN the earliest days of the radio broadcast era, in which we are now living, a receiver was judged almost entirely by the number of distant stations it could pick up. At that time, when the majority of broadcast stations operated around 360 meters, DX reception was indeed something of which one could be proud; but under the present conditions, when stations are using wavelengths from 200 to 550 meters, the reception of distant stations is not such a difficult matter.

Nevertheless, when it comes to listening to stations in another land, *that* is a horse of another color. Although many fans have made excellent records here in the United States there are comparatively only a few who have *consistently* heard any stations outside of this country with the possible exception of some in Canada. Even during the last International Tests, it is common knowledge that very few were able to pick up stations in Europe; and yet these stations, for the most part, operate on waves which the average receiver used in this country can easily tune in.

Whatever may be the causes of this inability to pick up foreign stations, there is one man who has made a record that is hard to beat. He is Jack Moskovita of San Pedro, California. From that city he has tuned in stations in Australia, New Zealand, Japan, Tasmania, Philippine Islands, South Africa, Cuba, Porto Rico, Hawaiian Islands, England, South America, Mexico and Canada. Surely a radio DX traveller *par excellence!*

ANTENNA EQUIPMENT

Mr. Moskovita's aerial structure consists of two towers, one 84 and the other 40 feet high. The aerial is of the cage type, made of No. 6 seven-strand, tinned, insulated wire. This wire has the insulation carefully removed and the wire separated, with the exception of that portion which serves as a lead-in. The hoops holding the wires in position are 13 inches in diameter and made of 5/16-inch tinned hard copper rods, with holes drilled to receive the wires. These hoops are spaced seven feet apart and soldered to the wires where the latter pass through them.

The top section of the antenna, which is suspended at an angle of 45 degrees is thirty feet long, the wires passing unfastened through an insulator at this point. Here the direction changes to vertical. This section is 18 feet in length, with hoops seven feet apart, their diameter decreasing toward the bottom of this section, as follows: 13, 9 and 4 inches. The wires, of course, are continuous throughout the whole length.

The insulated portion of the antenna starts six inches below the bottom hoop, passing, by means of a large porcelain tube, directly through the roof to the antenna post of the receiving set, to which a flexible connection is made with a short piece of stranded rubber-covered wire and with a snap-clip to connect this to the lead-in. A hard rubber cone-shaped guard is taped to the lead-in above the porcelain tube to prevent rain or moisture from entering the building.

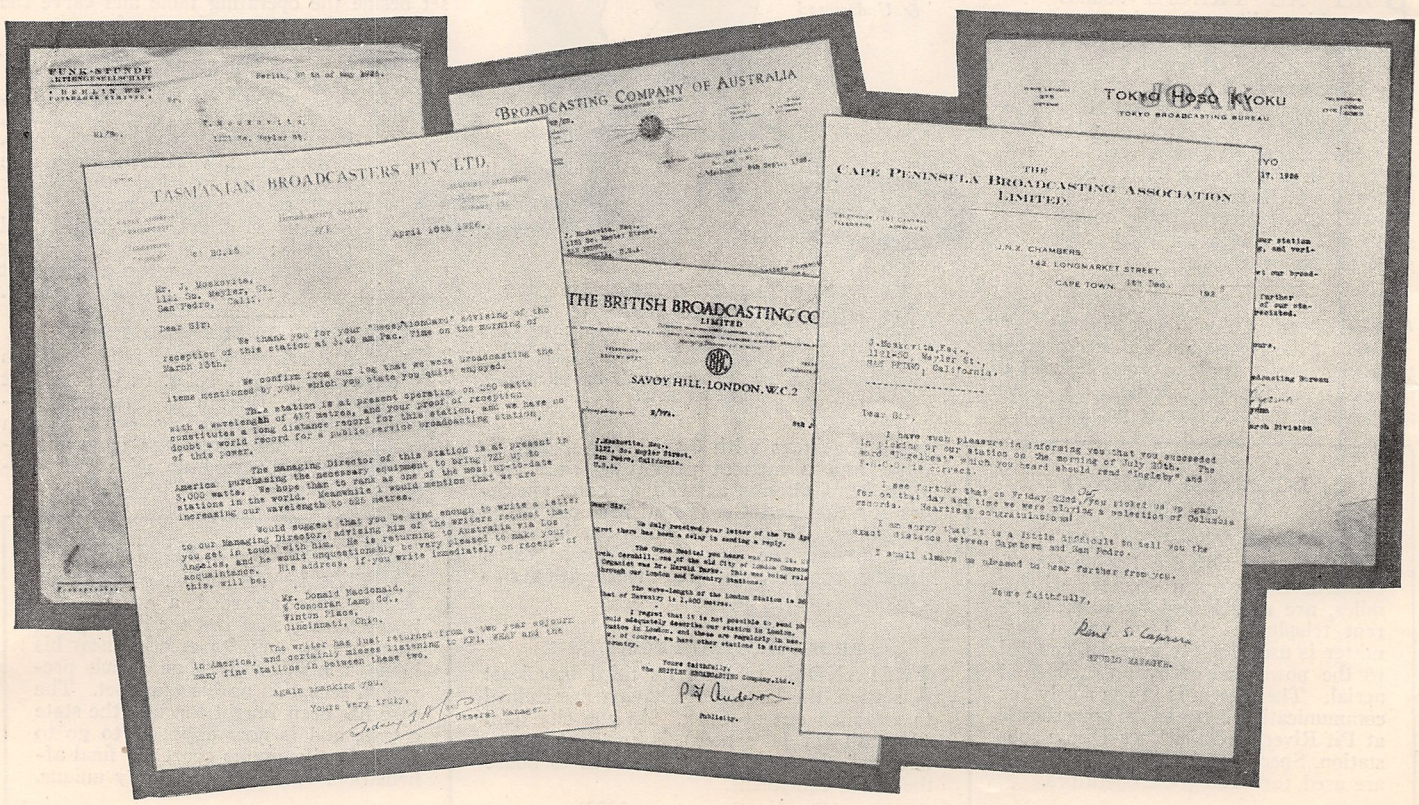
The ropes supporting the antenna pass through pulleys at the top and continue through screw eyes down to the base of each tower. To each rope is attached a weight, taking up any slack in the antenna or ropes and thus eliminating any unnecessary strain on the towers and equipment. The antenna points exactly east and west, the lead-in being taken off the west end.

THE GROUND

Mr. Moskovita's ground consists of 16 feet of ½-inch copper tubing, having holes drilled with a No. 40 drill spaced 6 inches apart along the entire length of the tubing, with the exception of the last three feet, which extends above the surface of the ground and to which is connected the ground wire of the set. One-quarter of an inch above each pair of holes is brazed a 3x5-inch plate of No. 18 gauge soft-roll copper, in the center of which is drilled a hole to slip it over the copper tubing. A copper-plated soft-iron ball, 6 inches in diameter, is brazed to the copper tube at the bottom, the tube extending entirely through the ball and being open at the bottom.

A post-hole digger was used to dig the hole as near the house as was convenient. The ground equipment, explained above, is placed vertically in the hole with the top plate about 12 inches below the surface of the ground. The three feet of the tubing above ground must be kept clear of the

(*Continued on page* 1295)



A few of the numerous letters received by Mr. Moskovita verifying his reception of foreign stations.

Gentlemen Prefer Broadcasts

By ROBERT FRANCIS SMITH

THE exploits of the "Master" have by this time become a classic. The author, Mr. Robert Francis Smith, has a knack for writing not only good radio stories, but entertaining and humorous ones as well.

In this story the "Master" seriously considers changing the weather by means of radio, a thing that may not seem at all so impossible twenty years hence.

LOVE is like a radio station that comes in faint—you tune in, get all warmed up and excited, and it signs off local.

The above smudge on the escutcheon of the world's greatest financial institution, marriage, is not the idle philosophy of an eighteen-year-old bachelor with a crystal set; it's the utter truth, founded on several years of super-hetting with a low-loss sample of how a perfectly good rib can be grounded. Understand me, I'm not even hinting at presumably.

On the contracts, we're Joe Hammerstein and Doris Darling, dainty exponents of the art of Terpsichore; at home in Brightmere-on-the-Deep, Long Island, we're plain Mr. and Mrs., and it gets plainer every day. As the poet remarked, marriage is like subscribing to a magazine—and if only we could purchase it from week to week!

A starring engagement with the *Inanities of* 1927 has kept us off our usual haunts, the several-a-day, and placed us on Broadway, the street of a thousand alleys. This permits daily commuting to our cottage small by a waterfall; and—as the curtain rises on the first act—it's a Sunday morning, the day of rest.

The legal annex is trying to get a sermon from station WHOA in New York City. Not that she cares particularly for sermons, but she met the minister once, and he had such adorable eyes!

"Joe, dear!" she yells, having the cans on and being unable to hear me practicing a new step. "Joe, do you know that you're a sinner?"

I stops my antics and peeks through the door. "What press report did you get that out of?" I demands.

Doris removes the DX boxes and adjusts the wavelength of her bob. "No press report, silly," she states, as matter-of-fact as though money were involved. "The minister just finished a talk about those who fall by the wayside."

I grunts. "All right, I'll bite. When and where, aside from the day we were married, did I fall by any wayside?"

Doris slips me a shortwave glare. "You never fall, dear," she says, frigid. "You lay down voluntarily."

Now you know why I spend my spare time over at the young castle of our boy friend, The Master.

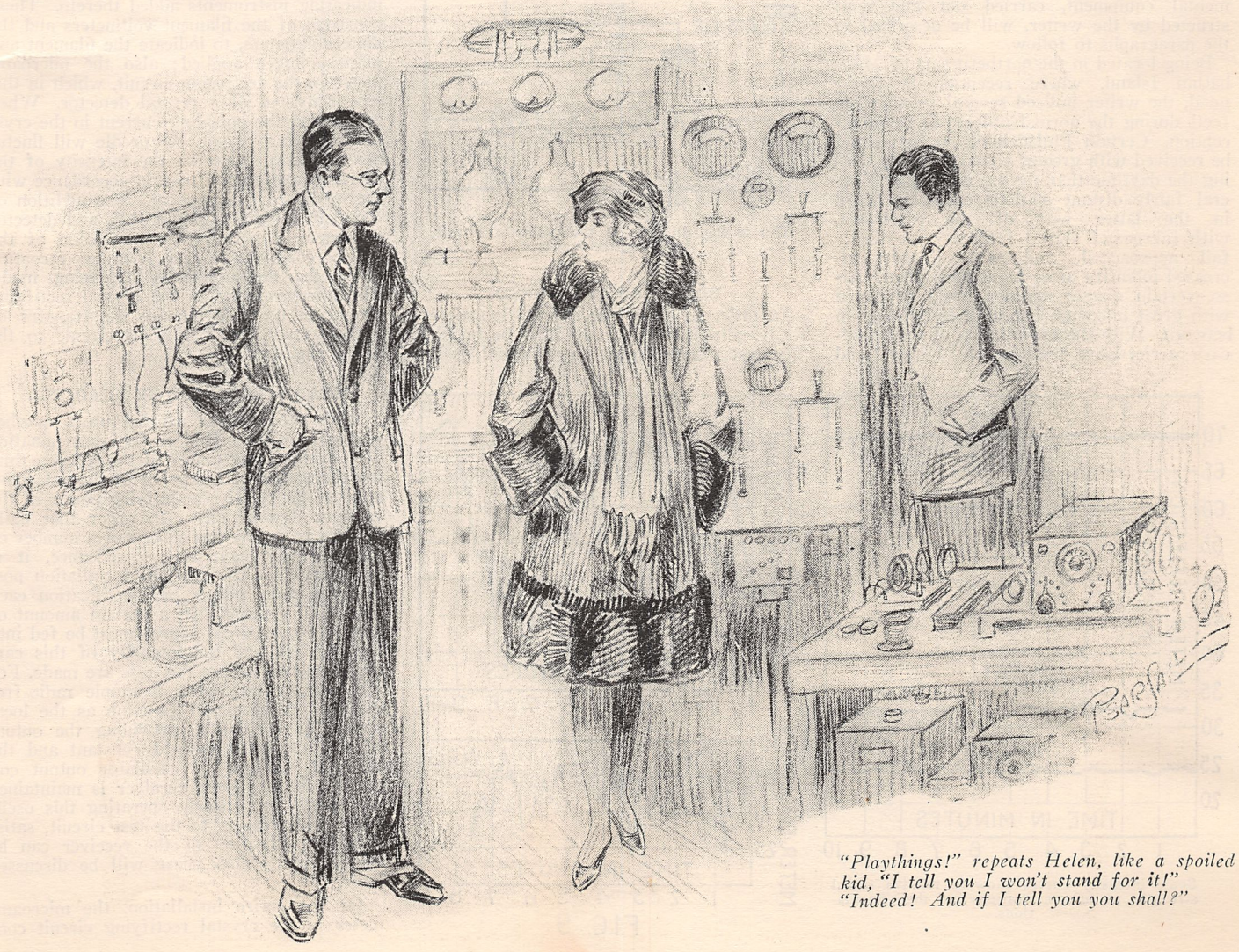
The Master is master of several things; for one, his own household, being an orphan, single and endowed by a father that cleaned up in a dozen places, even behind the ears. Also, Jerry Lawson has a healthy heft for science in general, with radio holding a sharp edge. On this Sunday in January I breezes into his new joint and as usual, Jerry's fussing with something. Seeing he's busy, I don't yelp beyond a howdy-do, and sets down on a loose pole transformer, and observes.

As I gazes, it wanders into the void between my ears that Jerry Lawson isn't to be sneezed at when it comes to looks. I never gave it a whole lot of thought before but, with a little attention to detail, our scientific neighbor is in the way of being a heart-rending sheik. He's nearing twenty-five, and is tall, slim, serious as cancer and usually devoted to wearing funeral-rimmed glasses. What probably forces the idea through my cranial vacuum is the fact that The Master is sporting a new pair of shell rims, only this time they're pure white.

So when Jerry lays down his tools and turns to me, the first thing I gaps about is the new lenses. They set off his features remarkably, he being rather dark-complected; and I can't imagine the reason for them, as The Master would be the last person in the world to try to start at the game of style-setting. He grins that faint grin of his as I pops the query.

"No, it's neither style nor looks," he explains. "It's merely a little experiment in the line of reflection and refraction. According to figures, white reflects more than black. Yet these white rims seem to be

(*Continued on page* 1282)



"Playthings!" repeats Helen, like a spoiled kid, "I tell you I won't stand for it!"
"Indeed! And if I tell you you shall?"

A New Field for Experimentation

The Tabulation of Received Carrier-Wave Intensity

By JOHN F. RIDER

THE pioneering work of Dr. G. W. Pickard in studying the antics of the carrier wave propagated from the broadcast station aerial, with the purpose of determining the association between the carrier-wave travel and solar, lunar and weather activities, opens a very interesting and beneficial field for experimentation by the interested radio fan.

Engineers throughout the world are devoting a great deal of time and effort to study of the broadcast carrier wave, in the effort to ascertain its actions under the influence of various forms of solar activity, in the transition periods between day and night and night and day, and under various weather and barometric conditions. It is hoped that the final analysis of their findings will solve the present mysteries surrounding radio transmission and fading. The solution of the problems of fading and the peculiar antics of carrier waves is of paramount importance to all concerned, radio fan and engineer alike; and this article is written in the hope that it will influence radio fans to join the ranks of these investigators of a problem of vital interest to the world at large.

HOW FANS MAY HELP

Fortunately, the work is not limited to engineers, or to individuals who bear a knowledge of technical radio. Every radio fan who is capable of constructing a receiver of even the simplest type can join in this work. Some of the experiments and the experimental equipment, carried out and constructed by the writer, will be described in the paragraphs to follow.

Being located in the northern part of Manhattan Island, where reception is fairly good, the writer noticed several peculiar effects during the normal process of radio reception. Certain Philadelphia stations could be received with greater signal intensity during the daytime than during the night. Several fairly distant stations could be heard in the latter part of the afternoon, with increased signal intensity as nightfall approached, and with greatly increased intensity after night had fallen. Also, certain distant stations could be heard with great intensity, but with bad fading in between. With the exploitation of the broadcast carrier-wave tests by Dr. Pickard and others, the writer considered the conditions existing at his place of reception ideal for similar work, and proceeded to construct simple equipment for the purpose.

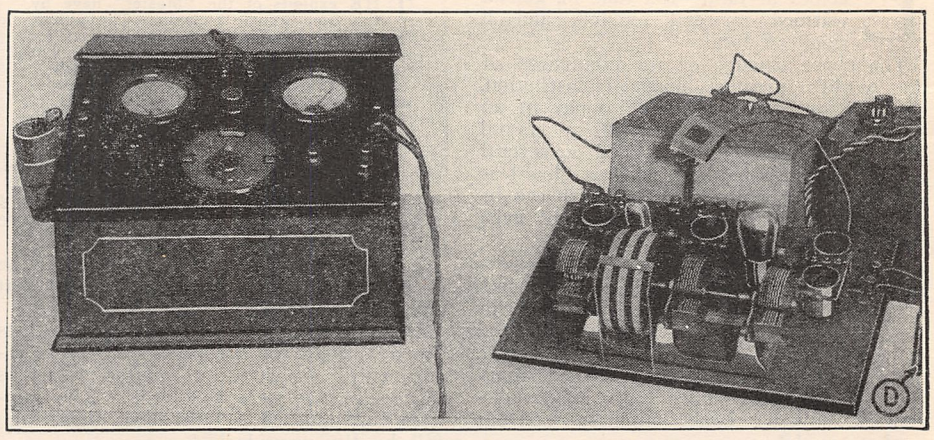


Fig. 2. At the left is shown the oscillator cabinet and on the right the R.F. amplifier. Note the crystal detector, D, at extreme right.

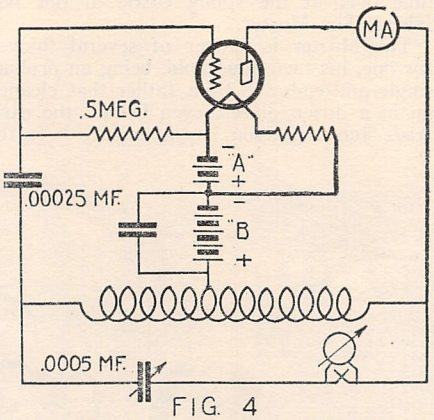


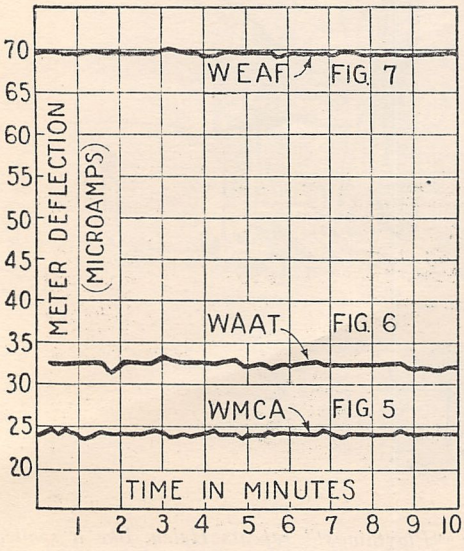
FIG. 4

The wiring diagram of the oscillator circuit, including the meters.

EQUIPMENT REQUIRED

In order to carry out this work satisfactorily, certain requirements must be fulfilled. The test receiver must be sufficiently sensitive, must be stable in operation and easy to control. The selection of the receiver suitable for this testing work was decided by the previously mentioned successful reception. It employed two stages of tuned-radio-frequency amplification, a non-regenerative detector and three stages of audio-frequency amplification. Since it is important that the carrier-frequency amplitude or intensity be calibrated, description of the type of audio amplification is unnecessary.

This receiver was chosen, with the proper indicating instruments added thereto. These consisted of the filament voltmeters and the plate voltmeters, to indicate the filament and plate voltages applied; also the microammeter in the rectifying circuit, which in this case consisted of a crystal detector. When registering the pulsating current in the crystal rectifying circuit, the needle will fluctuate in accordance with the intensity of the carrier wave, rather than in accordance with the modulating component. The addition of the A.F. amplifier to the R.F. and detector arrangement permits the utilization of the entire combination for regular reception while the measurements are being made. The microammeter in the crystal rectifying circuit in no way impairs the transfer of energy from the rectifying circuit to the audio amplifier.



Some intensity curves showing relative signal strengths of different stations and their fluctuations.

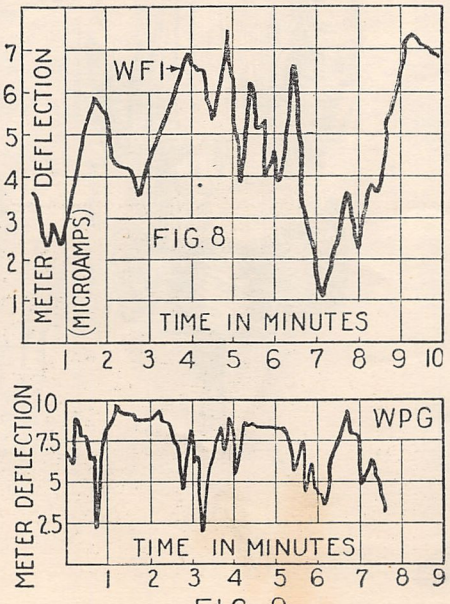
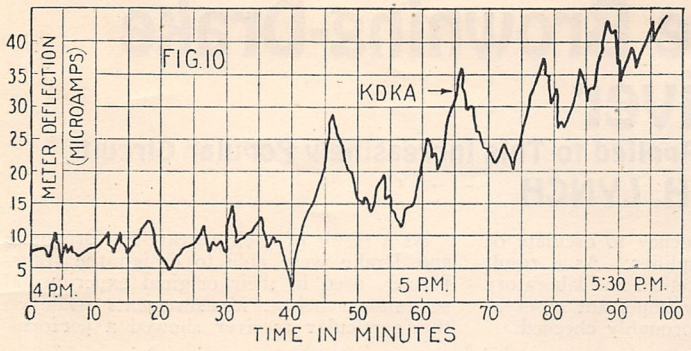


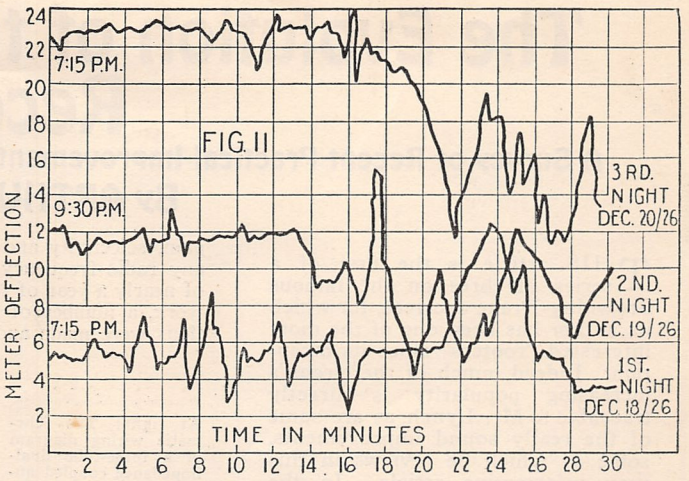
FIG. 9

STANDARDIZING THE READINGS

With the receiver decided upon, another problem arises. This is the determination of the amplifying power of the receiver during the period of test; that is, the determination of the relative amplifying power of the receiver day by day. In order that daily records from any one station or a number of stations may have any significance, it is necessary that the receiver installation possess the same power of amplification each day. This means that a certain amount of energy from a local source must be fed into the receiver and the intensity of this carrier tabulated before the tests are made. For all ordinary test work a simple radio-frequency oscillator will function as the local source of oscillation, providing the output of this oscillator is held constant and the distance between the oscillator output coil and the input of the receiver is maintained constant. By properly operating this oscillator, with respect to the test circuit, satisfactory calibration of the receiver can be carried out. This phase will be discussed later.

Of the entire installation, the microammeter in the crystal rectifying circuit con-

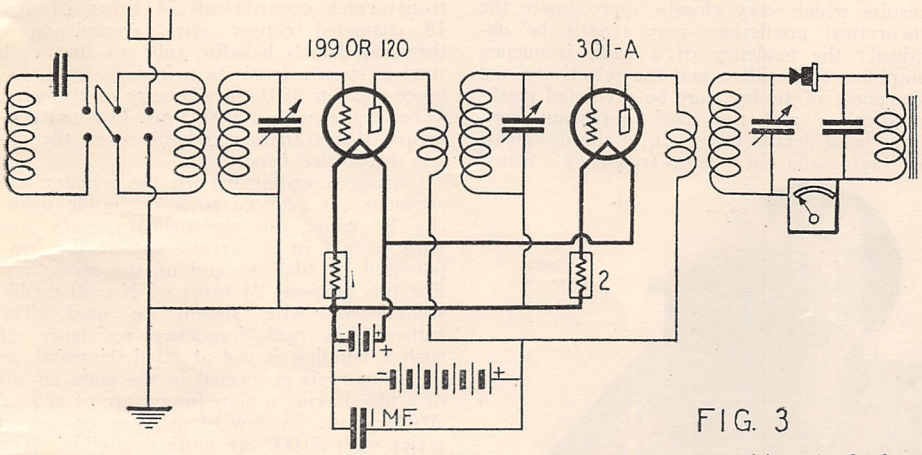




Reception curves of KDKA, Fig. 10, and WPG, Fig. 11.

stitutes the most expensive item. Unfortunately a cheap microammeter with a high current scale cannot be used, at least not for the tabulating of distant carrier-wave reception. Two courses are open to the interested fan. He either can purchase a new sensitive microammeter of the portable type shown in the accompanying illustrations or make a tour of the reputable second-hand stores dealing in such measuring instruments, and buy a used meter.

The complete installation, less the radio frequency oscillator and the loud speaker, is shown in Fig. 1. Reading from left to right, we see the R.F. amplifier, the microammeter and the A.F. amplifier. The crystal rectifier can be seen in Fig. 2 adjacent to the radio-frequency amplifier. The radio-frequency amplifier is tuned with a three-gang-drum condenser, thus permitting single-hand manipulation of the condensers, but still retaining the advantages of individual circuit tuning control. The inductances used are of the "figure-8" type, and were selected because they are practically fieldless. That is, their fields are so concentrated that interaction between the coils is eliminated and the pick-up of local signals very greatly reduced. By virtue of the reduced interaction between the coils, no trouble is encountered from uncontrollable oscillation. The tubes used were a 120 in the first radio-frequency stages and a standard 301A in the second. The crystal rectifier was a carborundum fixed unit.



The left-hand inductance has 15 turns of No. 24 D.C.C. wire on a 3-inch tube, and its series fixed condenser has a value of .0004-mf.

CIRCUITS USED

The microammeter illustrated has a 0 to 200 D.C. range, with 12 ohms resistance. The maximum current reading is 200 microammeters, divided into 100 divisions, of 2 microamperes for each division. The wiring diagram of the R. F. and crystal circuits is shown in Fig. 3. The audio amplifier used has three stages. A separate filament voltmeter is connected across each R.F. tube filament and a high-resistance voltmeter is connected across the battery supplying plate voltage to the R. F. amplifiers. These meters are used to facilitate the adjustment of the voltages so that they will be constant each day during the test period. If these applied D.C. voltages are maintained at constant values, we can assume that the amplifying power of the complete unit remains uniform and constant.

The coil and switch arrangement included in the aerial circuit permits the transfer of energy from the local oscillator into the aerial system of the R.F. amplifier. The oscillator is shown in Fig. 2, as the cabinet with the sloping panel on which are mounted two meters and a dial, with the necessary switches and binding posts. Its wiring diagram is given in Fig. 4. The two meters visible on the panel are a plate milliammeter and a thermocoupled galvanometer to indicate the current flowing in the oscillating circuit. If this current, the separation between the oscillator and the R.F. amplifier and the wavelength are all kept constant the same amount of energy will be transferred from the R.F. oscillator to the R.F. amplifier each time the latter is being calibrated.

PLOTTING SIGNAL STRENGTH

While it is true that this system appears crude, it will be found surprisingly satisfactory in operation, affording determinations of distant and local carrier-wave transmission. As a matter of fact many local stations are interested in learning the steadiness of their carrier in different parts of the surrounding territory, and the system shown herewith permits the attainment of some very interesting records.

Since the deflections of the microammeter in the crystal rectifying circuit are indicative of the intensity of the carrier, all observations are made with this meter. In view of the fact that no mechanical means are available to record automatically the fluctuations of the meter pointer, it will be necessary to jot down the deflections indicated by the needle. This means that the meter deflections will be plotted against time. The ordinate will be plotted in meter deflections and the abscissa in time. The actual time graduations are entirely up to the operator. It is suggested, however, that for distant station carriers the time graduations be in minutes, but for local stations in five or even ten minute periods. That is, when one is tabulating data on a distant station carriers, notations should be made every minute or even half minute, while with local station

(*Continued on page* 1293)

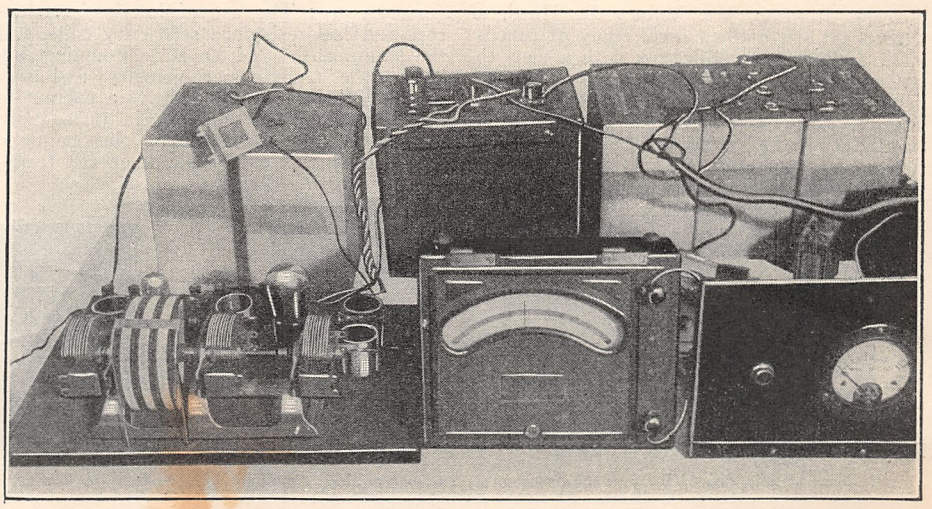


Fig. 1. The radio-frequency amplifier, meters and batteries used in the tests described above.

The Evolution of the Browning-Drake Receiver

A Survey of Recent Practical Improvements Applied to This Increasingly Popular Circuit

By ARTHUR H. LYNCH

THIS article is the first of a series of three on the famous Browning-Drake receiver, for which its author has been one of the most interested "rooters" since its inception. Indeed, much of the circuit's increasing popularity is directly traceable to Mr. Lynch, as are some of the really sound improvements, some of which he reviews in this very informative article. In the next of the series he will describe the design and construction of a 5-tube receiver, suited to operation with either batteries or a socket-power unit, and incorporating many of the principles outlined below.—EDITOR.

THE Browning-Drake circuit, instead of following the path toward oblivion of many other circuits which temporarily received national prominence through the radio press, has become more and more popular as time goes on, until now it is recognized as a standard by which the performance of others is judged.

In August, 1923, Glenn H. Browning and Fred H. Drake, engineering students at Harvard University, undertook, at the suggestion of the radio editor of the *Christian Science Monitor*, Mr. Volney D. Hurd, a theoretical and mathematical study of tuned-radio-frequency amplification with a view to determining the important factors to be considered in the design of such amplifiers. Messrs. Browning and Drake also developed, during the course of their work, formulæ and equations which would enable them to determine and predict the theoretical gain, selectivity and tendency to oscillate of any radio-frequency amplifier. As a result of nearly a year of theoretical and laboratory work, a number of very important observations were made and thoroughly checked.

At right: The schematic wiring diagram of a three-tube dual-impedance coupled audio-frequency amplifier with an output filter comprising a fixed condenser and a choke. Hi-mu tubes are used in the first two stages and a power tube in the output stage.

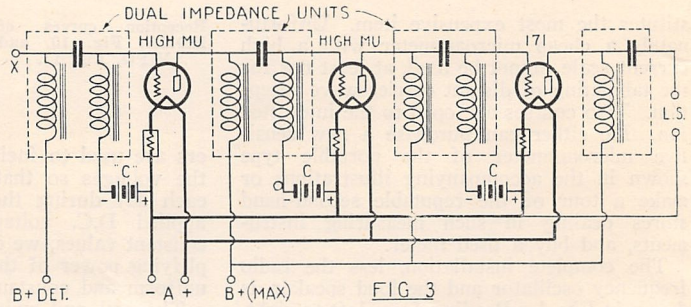


FIG 3

ORIGINAL RESEARCHES

It was found that, by the proper design of a radio-frequency transformer, practical results which very closely approximate the theoretical predictions may readily be obtained; the tendency of a radio-frequency amplifier to oscillate and the selectivity and sharpness of tuning may be predicted mathematically; and the most important constructional details to watch, in the design of a highly-efficient radio-frequency transformers, are: The use of low-loss condensers and low-resistance secondary coils, and the minimization of capacity coupling between the transformer primary and secondary. Such coupling induces a current in the secondary which is not in phase with that induced as a result of the magnetic coupling, so that the resultant energy transfer is greatly reduced.

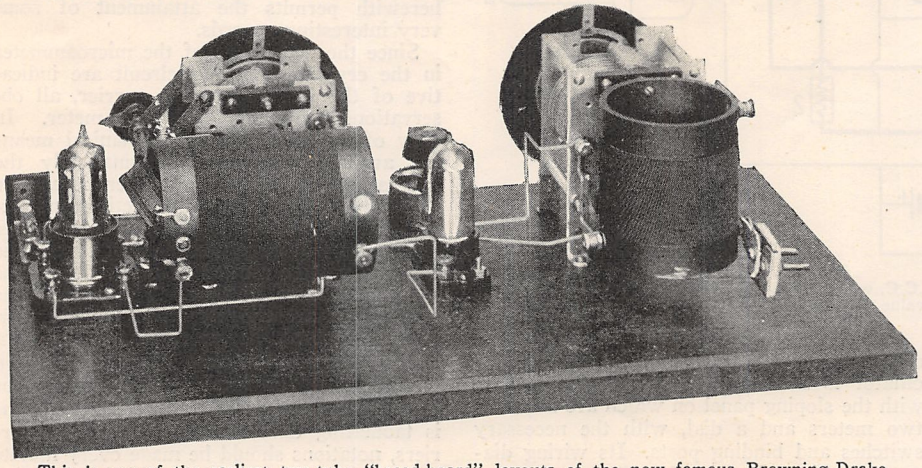
As a result of their researches, Browning and Drake were able to design the transformer, used in their original experimental set, shown below. Measurements made on this particular receiver showed a performance very close to that theoretically obtainable.

The secondary of the Browning-Drake transformer consists of 74 turns of No. 18 enameled copper wire, wound on a threaded 3-inch bakelite tube so that each turn is spaced from its neighbors by a distance equal to half the diameter of the wire. When tuned with a .00035-mf. low-loss condenser this transformer will cover the entire broadcast band.

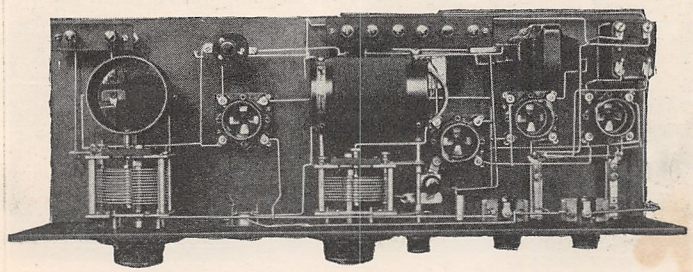
Capacity coupling betwen the primary and secondary is reduced to a negligible quantity by using, for the primary, very fine wire wound in a narrow slot at the low-potential or filament end of the secondary. For this purpose, 24 turns of No. 30 double silk-covered wire should be used. The rather high radio-frequency resistance of such a winding is not at all detrimental, as the primary is connected in the plate circuit of a tube having a plate impedance of around 20,000 ohms. A few ohms more or less in series with 20,000 are quite negligible. The use of larger wire to reduce the primary resistance would greatly increase the capacity coupling between the primary and secondary, and thus really decrease the overall efficiency to a marked degree.

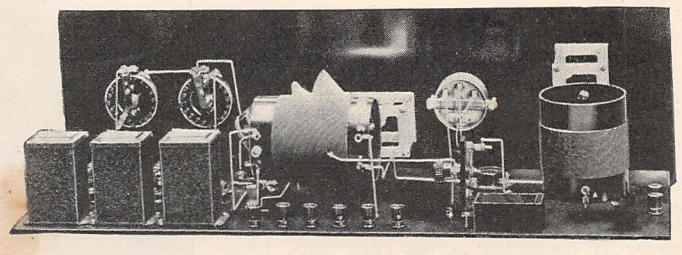
In developing the transformer without regeneration, the equations obtained indicated that with a tickler feed-back, or regeneration device, in the plate circuit of the detector tube and properly coupled to the transformer secondary, the signal strength could be increased between three and four times. Practical experiments soon confirmed this prediction.

Incidentally the addition of regeneration not only materially increased the distance-getting ability of the receiver due to increased radio-frequency amplification or "gain," but also materially increased the selectivity and facilitated cutting through the local stations. The tickler coil consists



This is one of the earliest two-tube "bread-board" layouts of the now famous Browning-Drake receiver. This unit was made several years ago, but incorporates many of the mechanical design features introduced by W. A. Ready, one of the prime movers in bringing the B-D into the favor it enjoys.





Above, at left, one of the four-tube receivers. Because of their simplicity of construction, this type was exceedingly popular, until other forms of amplification became available. At right: an impedance-coupled 5-tube set of a later period. This was designed by Mr. Browning especially for the home constructor, and its mechanical, as well as electrical merit, made it a favorite. Even today it will not suffer by comparison with many of the factory-assembled receivers.

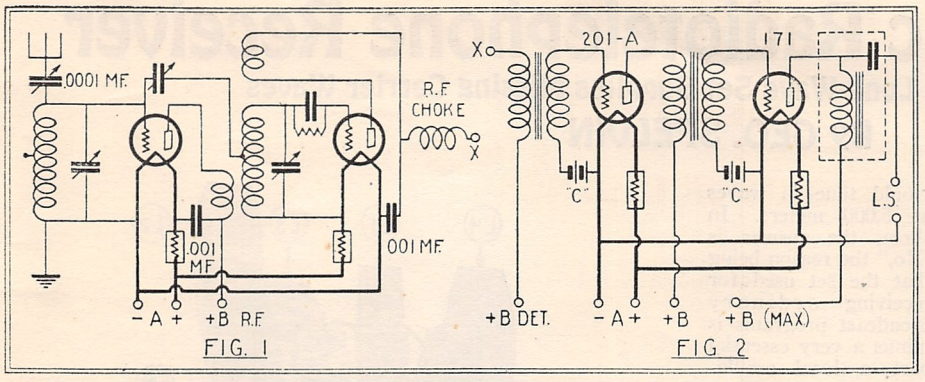


FIG. 1 FIG 2

of 20 turns of No. 26 wire on a bakelite tube 2½ inches in diameter.

IMPROVEMENTS IN CIRCUIT

Browning and Drake, in their work, used the 199-type tube as a radio-frequency amplifier. This tube was selected in preference to others because of the ease with which circuits employing it could be neutralized or balanced, and also because of its economical consumption of filament power. The short useful life of the 199 was not at that time fully realized.

Knowing the advantage to be gained in volume and reliability by the replacement of the 199 with a standard five-volt tube, several other engineers have worked on different types of neutralizing devices that could be applied to the B-D circuit so as to enable the use of the 201A-type tube as a radio-frequency amplifier. At last such a device has been perfected by John F. Rider and Arthur Moss. The "Phasatrol," as the new neutralizer is called, operates on a principle different from that of any of the other systems. As its name indicates, its function is to change the phase of the R.F. current in the plate circuit of the radio-frequency amplifier tube.

As the plate of the R.F. tube works into an inductive reactance (the primary of the R.F. transformer) the phase of the R.F. current in this circuit may be altered by the addition of a capacity in series with the transformer primary. As the D.C. component of the plate current will not pass through a condenser, energy must be supplied to the plate of the tube through a suitable resistor. The "Phasatrol" consists of a fixed condenser of the proper size mounted in a compact unit with a variable high resistance, which may readily be adjusted to meet the requirements of any set. By altering the phase of the R.F. plate current of the R.F. amplifier tube, oscillations due to plate-circuit energy getting back to the grid circuit and re-enforcing the grid voltage will not occur; as the fed-back energy will not have such phase relations with the grid voltage as to cause oscillation.

Mechanically the "Phasatrol," which is shown above, may be "one-hole mounted" under a sub-panel with just its adjustment screw exposed, or else may be mounted on a baseboard with the two screws provided for the purpose. The case is of molded bakelite.

With the "Phasatrol" used in place of the conventional system of neutralization originally employed by Browning and Drake, no difficulty is encountered in replacing the 199 R.F. amplifier tube with one of the 201A type. Not only is the reliability and stability of the set greatly increased by this change, but also its sensitivity and volume. But even better results are obtained by the use of a new radio-frequency amplifier tube, known as "Type K," which is very easy to neutralize and gives a much greater gain than ordinary tubes.

AUDIO AMPLIFICATION

The fundamental Browning-Drake circuit comprises only the radio-frequency amplifier and regenerative detector, using the special B-D coils. In fact, the original models, such as shown on the previous page, were merely two-tube affairs employing no audio amplification. Naturally, different writers in describing the Browning-Drake receiver in the past preferred, and thus described, different forms of audio amplification. The commercial receiver employing the B-D circuit designed by Mr. Browning employed, at the suggestion of the writer, three stages of resistance-coupled amplification.

During the past year great strides have been made toward the perfection of audio amplification. Transformer engineers, particularly George C. Crom, Jr., have developed transformers which give truly remarkable results; almost equal in fact, to the

(*Continued on page* 1266)

Fig. 1. The standard Browning - Drake circuit. Fig. 2. A two-stage transformer-coupled A.F. amplifier with an output filter. Below: The Phasatrol, a stabilizing device which Mr. Lynch has incorporated in the B-D receiver.

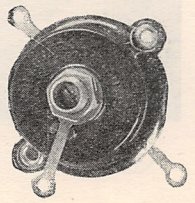
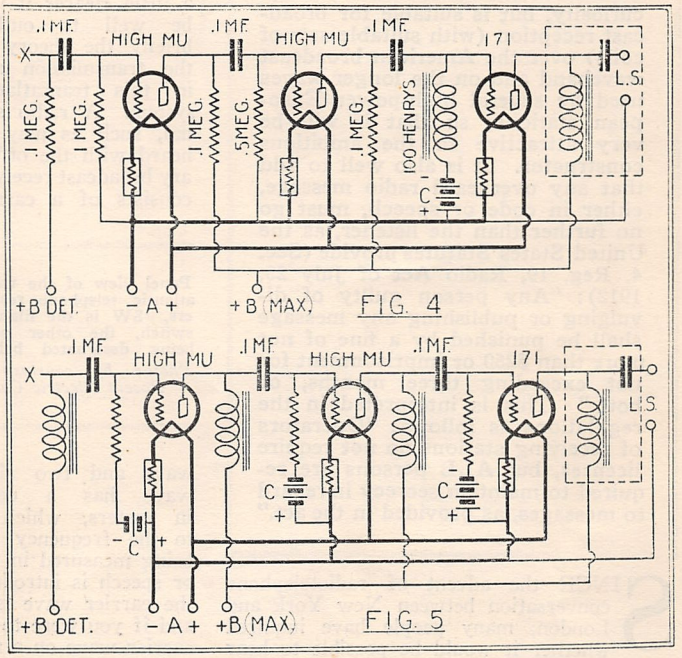
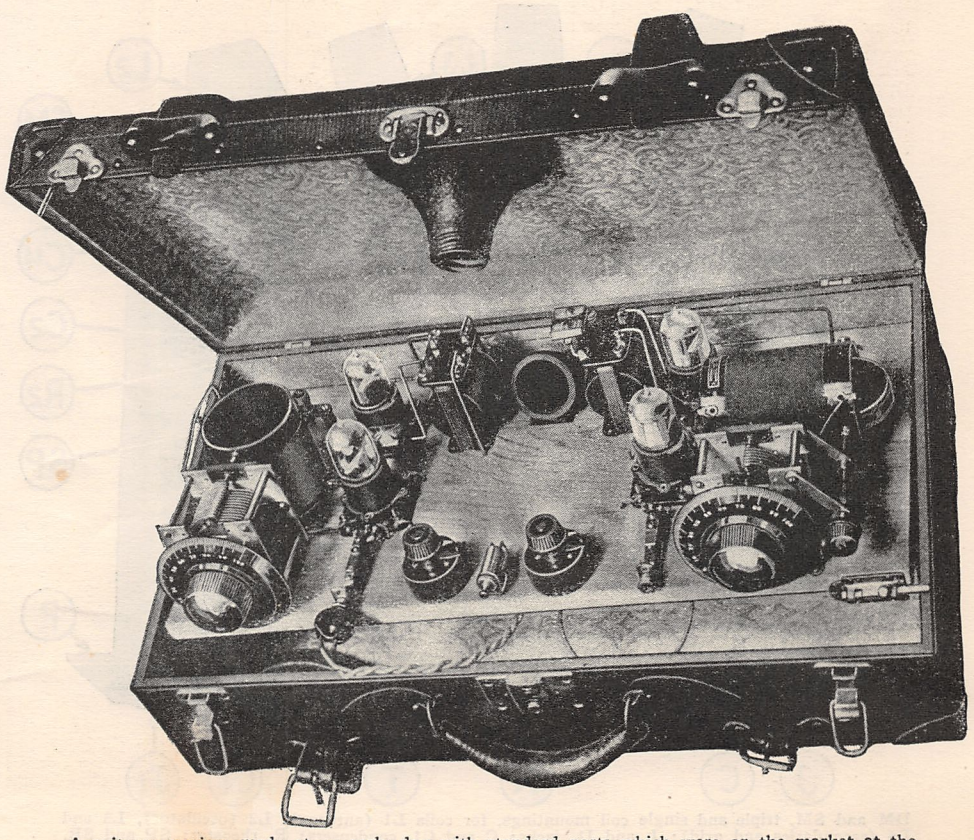


Fig. 4. A three-stage resistance-coupled A.F. amplifier employing a grid impedance for the power tube to eliminate "blocking." Fig. 5, an impedance-coupled A.F. amplifier with power tube and output filter.





A suitcase receiver made at an early day with standard parts which were on the market at the time. Room for the batteries is found under the base, which is on hinges.

A Transatlantic Radiotelephone Receiver

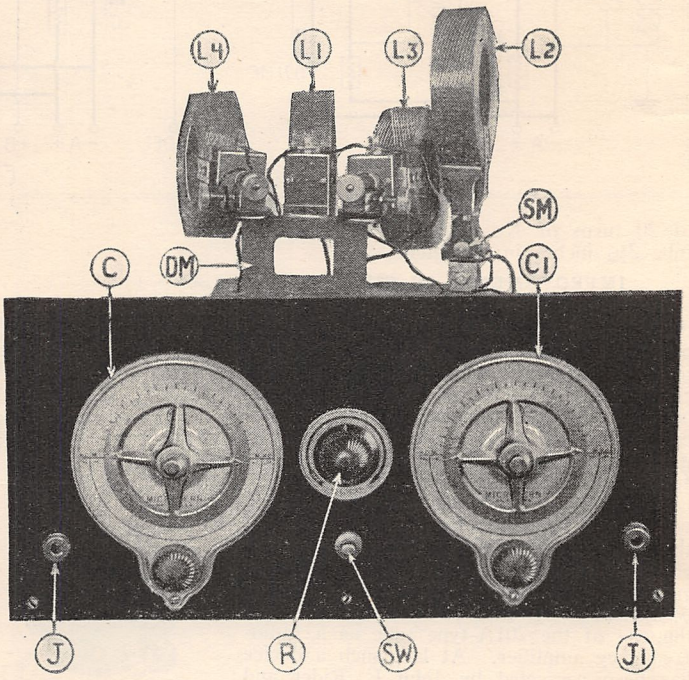
Local Oscillator In Long-Wave Set Supplies Missing Carrier Waves

By GEO. SPELVIN

THE possibility of hearing the transatlantic radiotelephone conversations has fired the enthusiasm of many radio fans, some of whom have already availed themselves of the privilege; and therefore this set will appeal to the experimenter. It is well to say, however, that the receiver described below is not restricted to the satisfaction of mere curiosity, but is suitable for broadcast reception (with suitable sets of coils) over the American broadcast waveband and on the longer waves used by several high-power European stations; so that it will be very attractive to the ambitious constructor. It is also well to add that any overheard radio message, either in code or speech, must go no further than the listener, as the United States Statutes provide (Sec. 4, Reg. 19, Radio Act of July 23, 1912): "Any person guilty of divulging or publishing any message shall be punished by a fine of not more than $250 or imprisonment for not exceeding three months, or both." This is interpreted in the regulations as follows: "Operators of receiving stations do not require licenses, but ALL persons are required to maintain secrecy in regard to messages, as provided in the act."

SINCE the advent of radiotelephone conversation between New York and London, many people have inquired whether it would be possible to hear these conversations, provided their receivers would tune in waves as 5,000 meters. In short, the answer is "No," the reason being that the set used for receiving ordinary broadcast programs is minus a very essential part—a local oscillator.

To make this point a little clearer it will be well to outline briefly the theory of the transmission used in this transatlantic system. A radio signal, such as may be heard with the ordinary broadcast receiver, consists of a carrier wave and two side bands. The carrier wave has a certain length measured in meters, which has a direct relation to the frequency of the wave, the latter being measured in cycles. Before any music or speech is introduced into the microphone the carrier wave is said to be unmodulated and if you were to tune-in this unmodulated carrier wave on a regenerative receiver, you would hear merely a steady whistle before you reached the peak of the wave. The side bands are introduced when someone speaks into the microphone. Therefore the combination of the side bands plus the fundamental carrier wave gives the final signal as it works out in broadcast practice, and as received by the usual set.



Panel view of the transatlantic telephone receivers. SW is the filament switch, the other parts being designated below. *Photos by courtesy of Pacent Electric Co.*

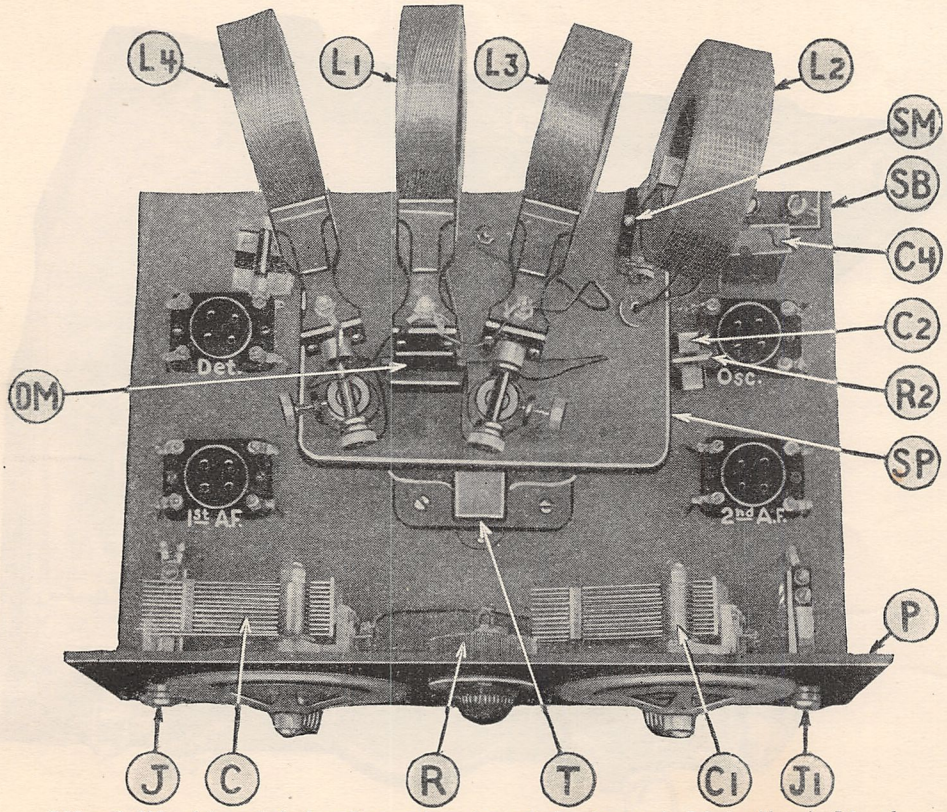
In the method employed for the new transatlantic telephone service the carrier wave and also one of the side bands are entirely suppressed. The manner in which this is done was explained in the March, 1927, issue of RADIO NEWS. However, the fact in which we are interested is that in some way this missing carrier wave and side band must be supplied at the receiving end. This is done by incorporating in the receiver a local oscillator tube and circuit, the output of which is heterodyned with the incoming side band, the result being the same as the usual wave which is picked up by an ordinary broadcast receiver.

DESCRIPTION OF RECEIVER

The four-tube receiver, which is illustrated herewith, easily tunes in the transatlantic radiotelephone conversations, which are transmitted on a wavelength of 5,260 meters. With a fairly long antenna it is possible to tune-in both sides of the conversation, generally with fair loud-speaker volume. However, the experimenter must not consider this receiver as useful for single-side-band reception alone, as it may be used for receiving any stations, on any wavelengths whatsoever, merely by changing the inductances and removing the oscillator tube, V2.

It is of interest also to note that 22 meters is the wavelength used for emergency. Daily, both the 5260- and 22-meter wavelengths are tested and whichever is best is used for that day. If the 22-meter band is used both sidebands as well as the carrier wave are employed, so the receiver herein described could not be used that day for transatlantic telephone reception.

The schematic wiring diagram of the set shows the added feature required to bring in the new transatlantic telephone transmission. The oscillator tube, V2, with its accompanying coil, L2, supplies the missing carrier wave



DM and SM, triple and single coil mountings, for coils L1 (antenna), L2 (oscillator), L3 and L4 (secondaries and grid); J. and J1, jacks; C and C1, condensers; R, rheostat; SP and SB, sub-panel and sub-base; T, A.F. transformer; C4, 1-mf. condenser and C3 (lettered above C2) and R2 grid leak and condenser.

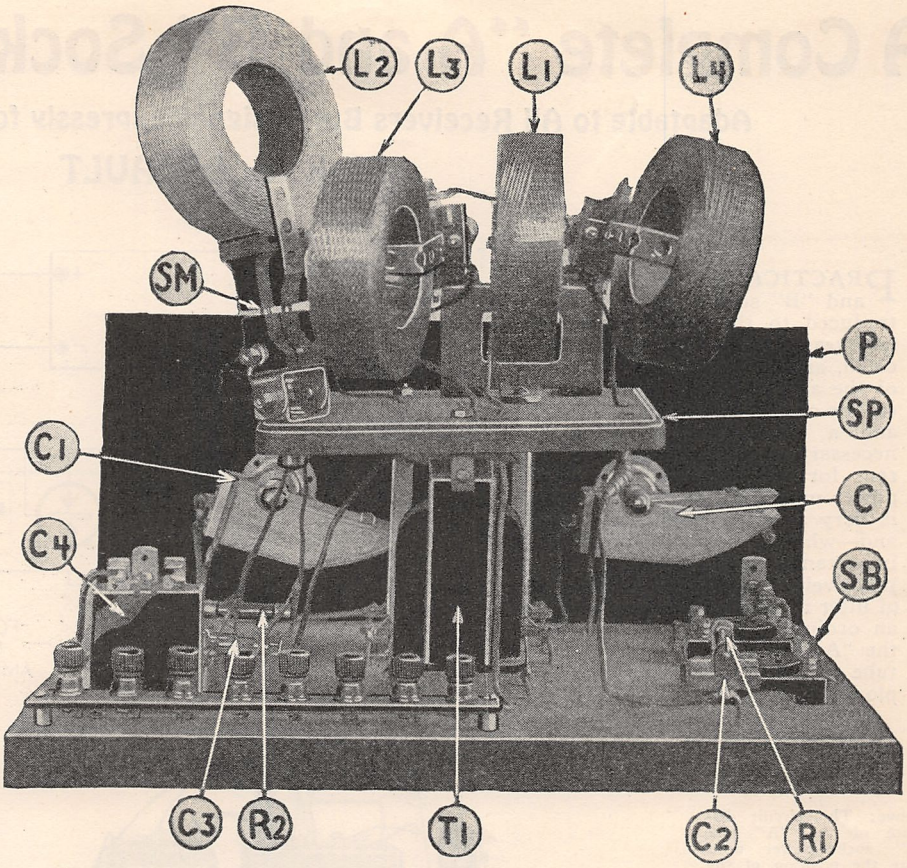
of the transmitted signal and completes the signal, which is detected in the usual manner and amplified by means of the two stages of transformer-coupled amplification.

THE ASSEMBLY

The assembly itself is relatively simple and free from complications. On the panel are mounted the two variable condensers, C and C1, of the S.L.F. type having a capacity of .0005-mf., the first and second stage jacks, J and J1, and the 6-ohm rheostat, R. The remainder of the apparatus is placed on the baseboard and an elevated sub-panel. This platform is constructed over the two audio-frequency transformers, T and T1, which are mounted in the center of the baseboard. On this platform are installed the two mountings, DM and SM, the former being for three coils, L1, L3 and L4, and SM being used for the oscillator coil, L2. The disposition of the vacuum tube sockets can be seen from the accompanying illustration showing the plan view of the baseboard, two being on each side of this platform.

The 1.0-mf. fixed condenser is mounted near the rear of the baseboard on the left, and behind it is placed the binding post strip. Although no views beneath the baseboard are shown, it should be remembered by the constructor that the wires connecting the different instruments should be as short as possible. Most of the connecting leads are run under the baseboard.

The values of the duo-lateral coils which are given in the accompanying list of parts will allow the set to be tuned to a wavelength of 5,260 meters. A voltage of 90 is used on the plate of the two audio-frequency amplifier tubes. The value of the necessary plate voltage for the particular detector used will depend upon the tube. Tubes of the 201A type may be used throughout, but if the experimenter prefers he can use a special detector tube, and also a 112 type tube in the last stage of the audio amplifier with 135 volts "B" battery. If such a voltage is employed then it will be necessary to use a negative grid bias, on the 112 tube, of 9 volts; otherwise 4½ volts can be used. It may be necessary to change the tubes about in their sockets until the best combination is found.



T1, A.F. transformer; L1, antenna coil; L2, oscillator coil; L3 and L4, secondary and grid coils; C1, oscillator condenser; and C2-R1 and C3-R2, grid leaks and condensers.

Photos by courtesy of Pacent Elec. Co.

As mentioned previously, the antenna length is rather important. For best results one between 150 and 200 feet will be about right to receive both London and New York. With a shorter antenna it will be possible to pick up the American end of the circuit, but getting the London side will be more or less of a gamble.

TUNING THE RECEIVER

In tuning the set first plug a pair of headphones into the jack J, this being the first stage of the audio-frequency amplifier. If this is your initial experience with a receiver of this type, it will be found a bit peculiar in operation. There is no sharp peak to the signals, as there is to those of the broadcast waves. The set may seem broad in tuning, the closest comparison being a rather broad-tuning non-regenerative broadcast receiver. However, once the knack is mastered, you will find a point where maximum volume and clarity is obtained, although it will not be at a definite peak as on the regular broadcast receiver.

As you look at the four honeycomb coils from the front of the receiver they are as follows: At the left of the three-coil mounting, DM, is the grid or pick-up coil, L4, of the non-regenerative receiver. In the center of this mounting is the antenna coil, L1. Next comes the grid coil, L3, of the oscillator. In the single mounting, SM, is the plate coil of the oscillator, L2.

Close coupling should exist between the grid coil of the receiver and the antenna coil; somewhat looser coupling between the antenna coil and the grid coil of the oscillator; and the coupling between L2 and L3 will have to be determined after the set is placed in

(*Continued on page* 1264)

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER ★	
L1,L2	2	Duo-Lateral coil	1,000turns	Long-Wave Coils	1	
L3,L4	2	Duo-Lateral coil	1,250turns	Long-Wave Coils	1	
C, C1	2	Var. Condensers	.0005 mf.	SLF type	1	7,8,9,14
C2,C3	2	Grid Condensers	.0005 mf.	With grid-leak clips	2	20,21,22,23,28
C4	1	Fixed Condenser	1 mf.	By-pass	2	20,21,22,23,28
R	1	Rheostat	6 ohms	Fil. control to all tubes	1	14,16,17,18,19,29
R1,R2	2	Grid Leaks	2 meg.		2	22,24,27,28
T, T1	2	A.F. Transformers	3tol ratio	New type	1	7,8,14,25,26
J	1	Jack		Double circuit. First audio	1	16,18,19
J1	1	Jack		Single circuit. Output	1	16,18,19
SW	1	Filament switch			1	16,18,19,29
DM	1	Coil mounting		For three coils	1	
SM	1	Coil mounting		For one coil	1	
	2	Dials		Vernier type	1	4,7,8,17
	4	Sockets		UX type Non-microphonic	1	4,7,14,30
	4	Tubes	5v. ¼ amp.	Standard type	3	10,11
P	1	Panel		7 X 14 X 3/16"	6	12,13
SP	1	Sub-panel		5 X 6 X 1/2" (wood)		
SB	L	Sub-base		10 X 14 X 1/2" (wood)		
	1	B P strip		7½ X 3/4 X 3/16"	6	12,13
	8	Binding Posts			4	14,15
	One Roll	Hookup Wire			5	

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Pacent Electric Co.
2 Electrad, Inc.
3 Radio Corp. of America
4 H. H. Eby Co.
5 Belden Mfg. Co.
6 Micarta Fabricators
7 Silver Marshall, Inc.
8 Samson Electric Co.
9 Hammarlund Mfg. Co.
10 E. T. Cunningham, Inc.
11 C. E. Mfg. Co. (Ceco)
12 Insulation Co. of Amer. (Insuline)
13 American Hard Rubber Co. (Radion)
14 General Radio Co.
15 X-L Radio Labs.
16 H. H. Frost
17 Martin-Copeland Co. (Marco)
18 Carter Radio Co.
19 Yaxley Mfg. Co.
20 Aerovox Wireless Corp.
21 Polymet Mfg. Corp.
22 Tobe Deutschmann
23 Sangamo Electric Co.
24 Int. Resistance Co. (Durham)
25 American Transformer Co.
26 All American Radio Corp.
27 Daven Radio Co.
28 Dubilier Cond. & Radio Co.
29 Allen-Bradley Co.
30 Benjamin Electric Co.

If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible difference in size from those originally used in laying out and drilling the panel and sub-base.

FORM COPYRIGHT EXPERIMENTER PUB. CO. 1927

★ THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

A Complete "A and B" Socket Power Unit*

Adaptable to All Receivers But Designed Expressly for the LR-4 Ultradyne

By R. E. LACAULT

PRACTICALLY all of the "A" and "B" socket-power units introduced to the public within the last year have been rather complicated, and often beyond the means of the average radio fan. The use of one or more large rectifier tubes and a large filter network was necessary to pass enough pure current for the tube filaments. The power unit described in this article is very simple, unusually compact and—what is probably of greatest importance to the radio fan—comparatively inexpensive. A new type of filter is used, in conjunction with an ordinary charger for supplying the "A" current. A small rectifier tube of the filamentless type is employed in the "B" unit.—EDITOR.

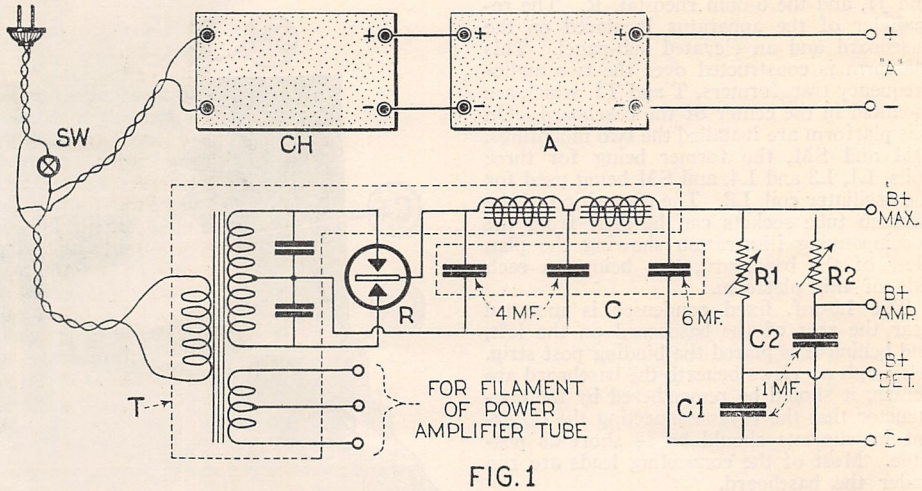
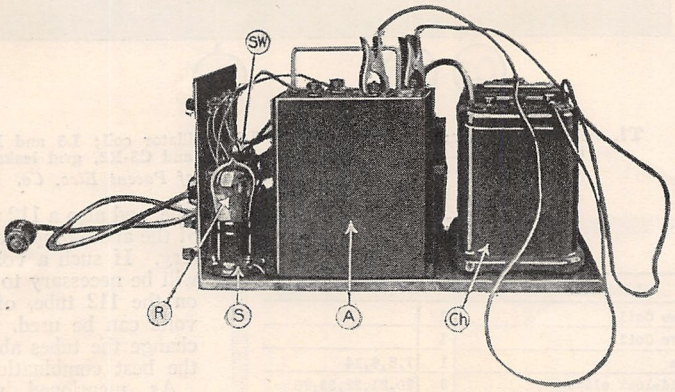
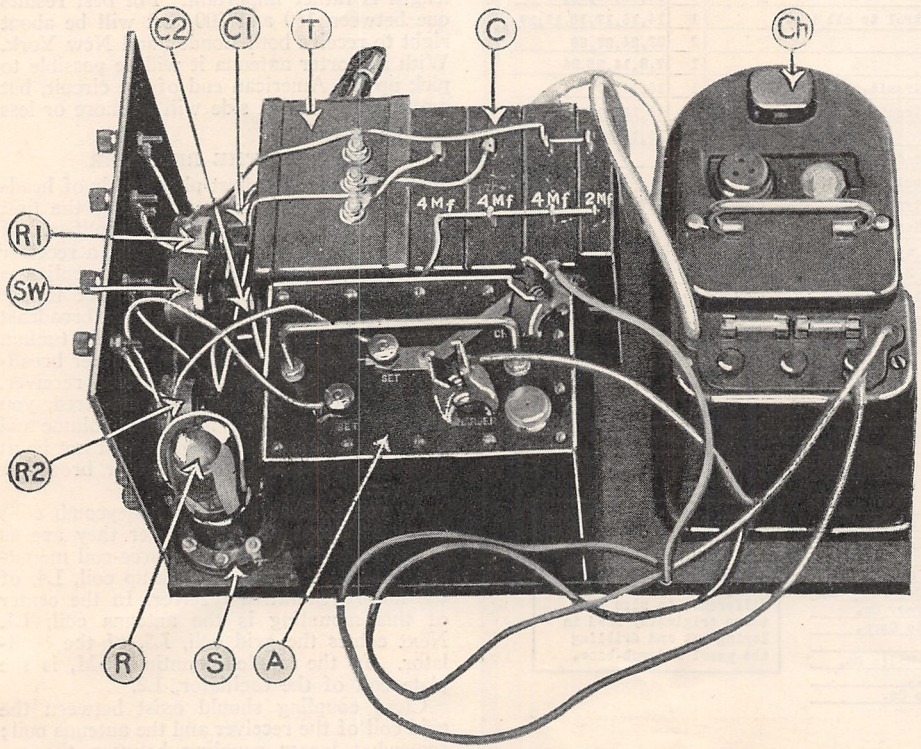


FIG. 1

Above: The circuit diagram of the "A" and "B" socket-power unit. Note the position of the control switch SW. The extra winding on the power transformer with three terminals will supply current and "C" voltage for a power tube if connected as shown in Fig. 2.

Right: Side view of the "A" and "B" power unit. The parts are as designated in the large view, below.





A top view of the alternating-current "A" and "B" socket-power unit. Ch is the charger which is a filter unit. T is the power-compact, which is part of the "B" power unit. C is a condenser bank totaling 14 mf. in capacity, which is used in conjunction with T. R is the filamentless rectifier tube and S its socket. R1 and R2 are the "B" voltage regulators, which are "by-passed" by condensers C1 and C2. SW is the main control switch, which turns on and off the whole unit.

*RADIO NEWS *Blueprint Article No.* 14. (*Photos courtesy of Radio Electric Laboratories*)

THE last year has witnessed several improvements in radio receivers. Shielding, power amplification and battery elimination have been the most outstanding, and they show a trend to bring radio to the point where receivers will be as simple, practical and efficient as any of the many electrical appliances now used in the home.

The problem of battery elimination is the most difficult to solve for the home builder; because it is difficult to rectify and filter enough current to supply the filaments of the tubes when connected in *parallel*. In a factory-built receiver the circuit may be altered and adapted to a series-connection system, or small low-consumption tubes may be used; the set may thus be "electrified," but these methods cannot always be adapted to home-made sets. We are pleased to present here an "A and B" socket-power unit, which is built entirely from standard parts and which may be used with any set to supply the filament and plate current from the 60-cycle A.C. lighting system. This unit was first developed to supply the new LR-4 Ultradyne receiver (which was described in the January issue of RADIO NEWS), but it may be used with any receiver.

The "A" unit delivers 6 volts and up to 3 amperes, depending upon the type of charger used. This is sufficient to supply a maximum of twelve ¼-ampere tubes or their equivalent. By the use of a series connection, as explained herein, even more tubes may be operated from the "A" unit. The "B" supply unit delivers up to 250 volts, depending upon the load, and will supply superheterodynes or other multi-tube sets without generating a hum. A filament winding is provided to light the filament of the power tube, this arrangement increasing the number of tubes which may be used in the receiver.

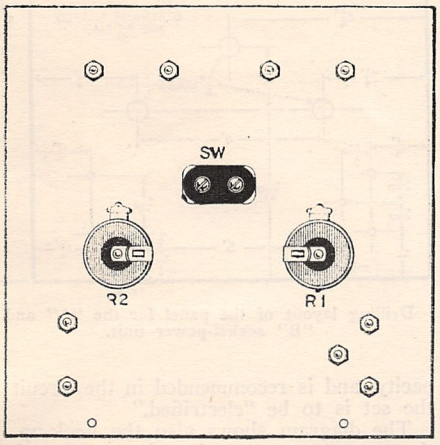
CONSTRUCTIONAL DETAILS

The power unit is built entirely of standard parts and is composed of a "B" socket unit, a standard "A" battery charger and a special filter through which the charger supplies the tube filaments directly. The various items used here have already been described in the "What's New in Radio" section of this magazine.

The list of parts required for the construction is given in the specification sheet. The size of charger to use is determined

only by the number of tubes to be supplied by the "A" power unit. For six tubes or less, a 2½-ampere charger of the chemical type is satisfactory, but for larger sets a bulb charger of five-ampere capacity is required.

The connections are clearly shown in the diagram, no lengthy explanation of the hook-up being necessary. The "B" supply unit comprises a special metal casing, containing the power transformer, two filter chokes and the 0.1-mf. buffer condensers. The usual bank of condensers is used, together with the necessary variable resist-



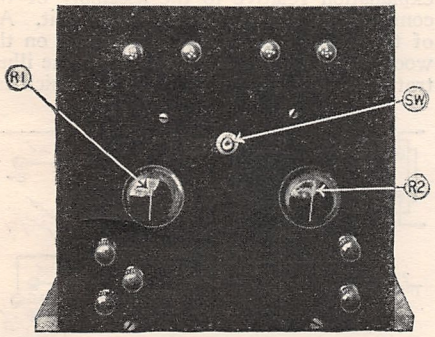
Layout of panel for the "A" and "B" socket-power unit, as seen from the rear.

ance to control the "B" voltage supply to the set.

If the filament winding provided for the power tube is employed, the leads from the set to the power unit should be twisted together, as this removes the tendency to hum and leaves the output of the receiver clear and free of noises.

Fig. 2 shows the connection of the power tube, which may be installed in any set. It is merely necessary to change the connections to the filament, grid and plates so that the proper voltages may be applied to this tube.

If a small charger is available and it is desired to use this with a set containing

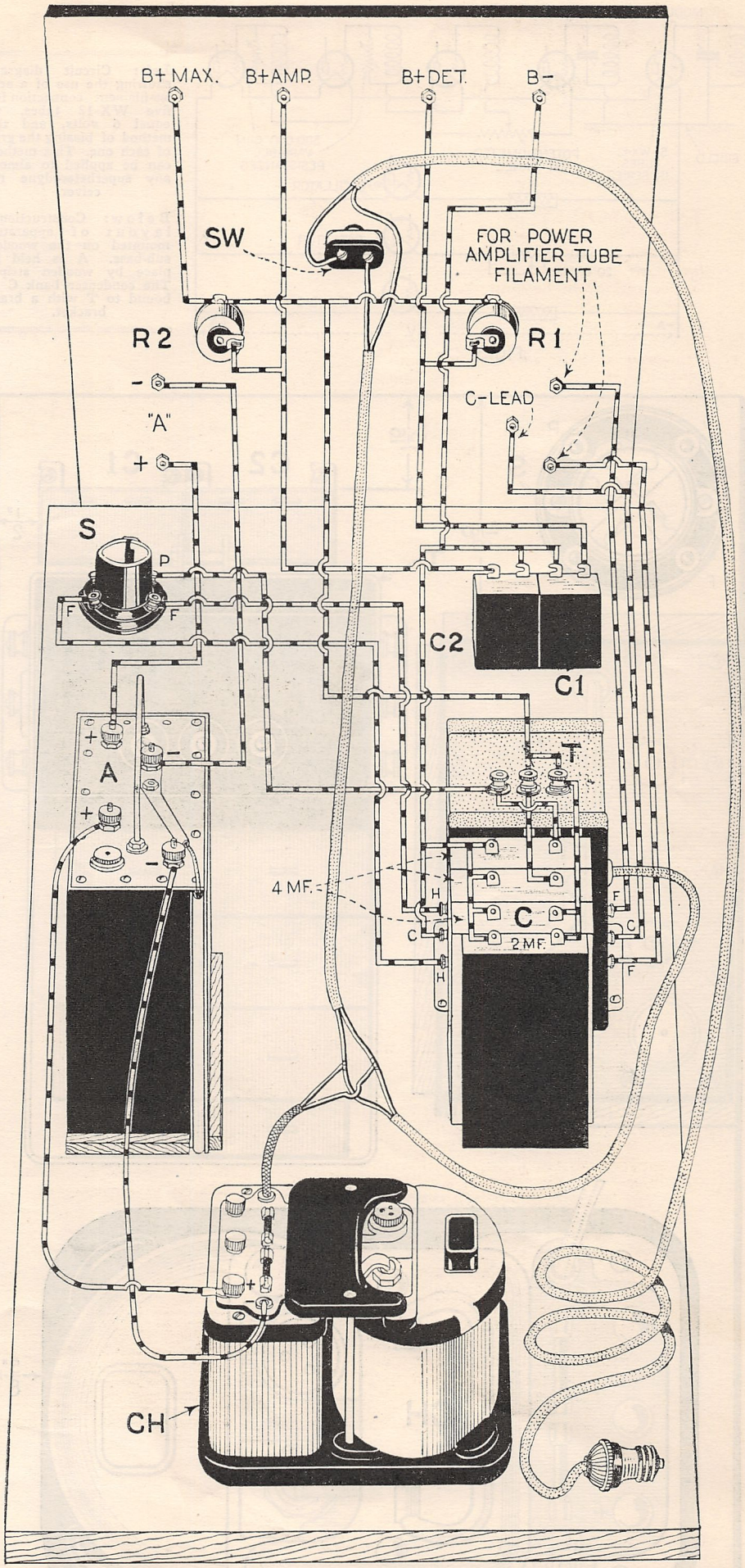


A front-panel view of the completed unit. R1 and R2 are the "B" voltage regulators (each having a maximum resistance of about 50,000 ohms) and SW is the control switch. The four "B" posts are at the top of the panel.

seven or eight tubes, or even more, some of the filaments may be connected in series, as shown in Fig. 3, which is a diagram of the mid-frequency amplifier of the Ultradyne. In this case it is necessary to use a slightly different arrangement to control the grid bias, since the filaments are connected in series.

USE OF SMALL TUBES

The arrangement shown in Fig. 3 is entirely satisfactory for any standard super employing potentiometer control to stabilize



Complete layout and wiring of the "A" and "B" socket-power unit. The parts here carry the same symbols as in the other illustrations and diagrams. It is a good idea to color each connection on this drawing with crayon, as the respective wires are put in the unit. This makes it easy to check up on your work. Note that there are only three connections made to the rectifier tube sockets. A indicates the "Abox."

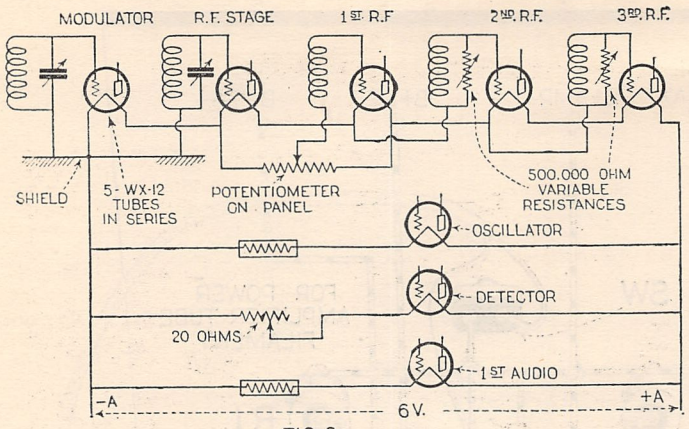
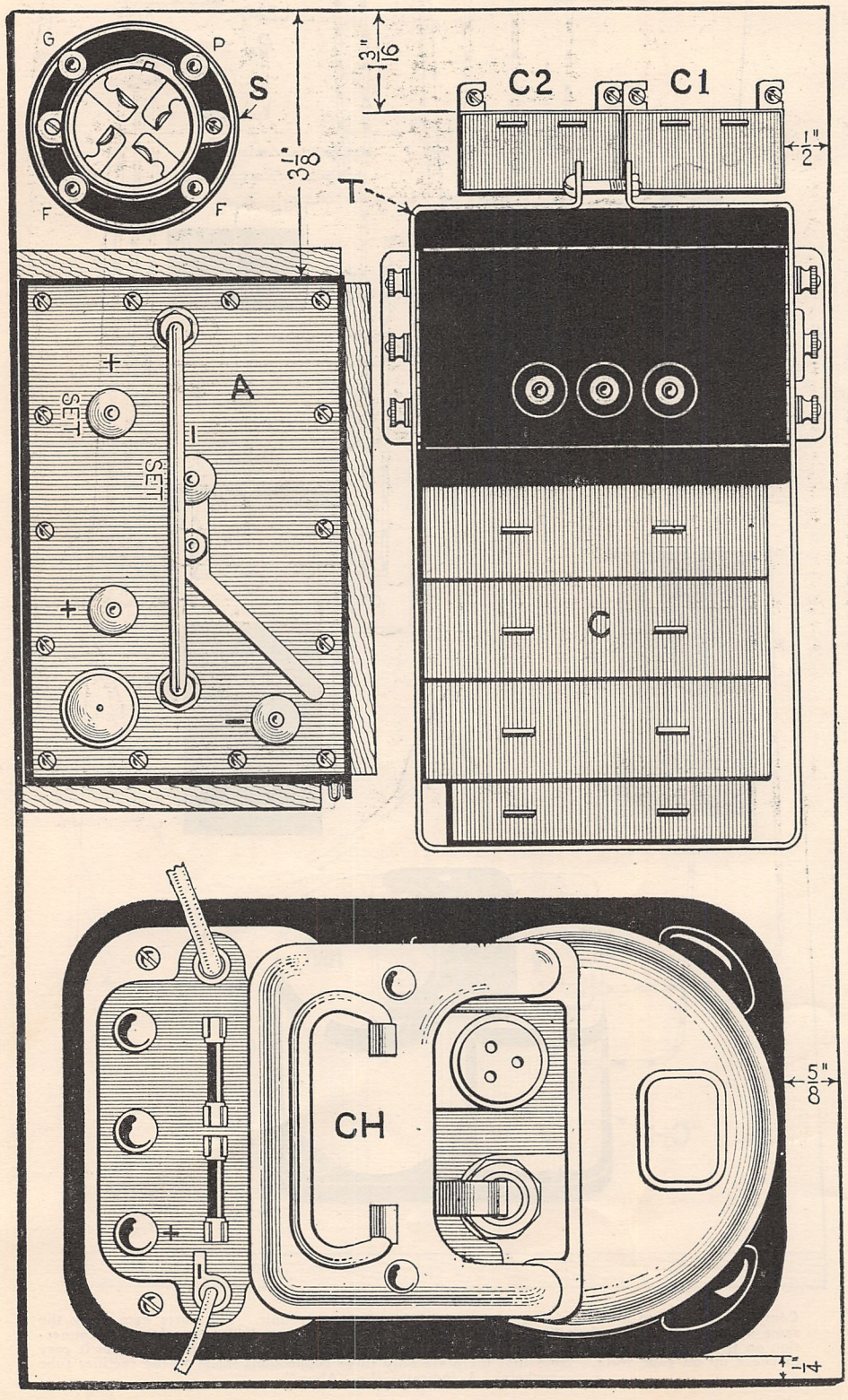


FIG. 3

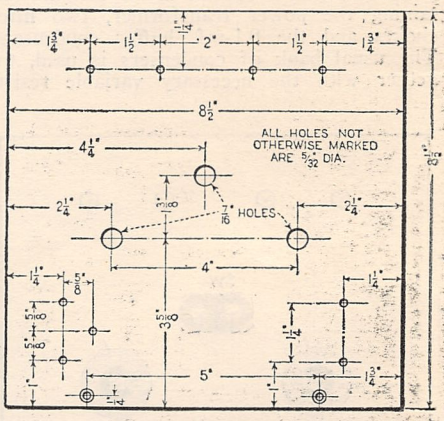
Left: Circuit diagram showing the use of a series-filament connection for five WX-12 tubes, to equal 6 volts, and the method of biasing the grid of each one. This method can be applied to almost any superheterodyne receiver.

Below: Constructional layout of apparatus mounted on the wooden sub-base. A is held in place by wooden strips. The condenser bank C is bound to T with a brass bracket.



the amplifier, and may be used if it is desired to reduce the filament consumption. In this case, small tubes consuming only ¼-ampere at 1.1 volts, such as the WX-12, are used so that when they are connected in series, five of them take no more current than one 5-volt, ¼-ampere tube.

The use of such small tubes increases the selectivity, due to their small grid-plate ca-



Drilling layout of the panel for the "A" and "B" socket-power unit.

pacity, and is recommended in the circuit if the set is to be "electrified."

The diagram shows also the hook-up of the potentiometers and resistances required to control the intermediate-frequency amplifier, which is quite stable and functions with negative grid bias on the tubes. This arrangement increases the efficiency of the amplifier.

The whole unit is built on a board, with a control panel supporting the various binding posts, voltage regulators and switch. The cord supplied with the power transformer of the "B" unit may be cut and spliced with that of the charger, thus permitting a single switch to control both instruments. This is shown in the diagram. The use of a filament switch on the receiver itself is unnecessary, since the "A and B" power may be turned on and off by means of the switch mounted on the power unit.

ASSEMBLY OF UNIT

It will be well to offer a few words of explanation relative to the assembly of the complete "A and B" socket-power unit. All of the weighty apparatus is mounted on the wood sub-base, as can be seen from the illustrations. The power compact T, which in-

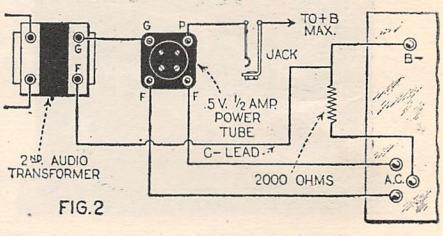


FIG. 2

This shows how to connect the filament of the power tube to the power supply unit. "C" voltage for the grid is supplied by the drop of potential across the 2,000-ohm resistance.

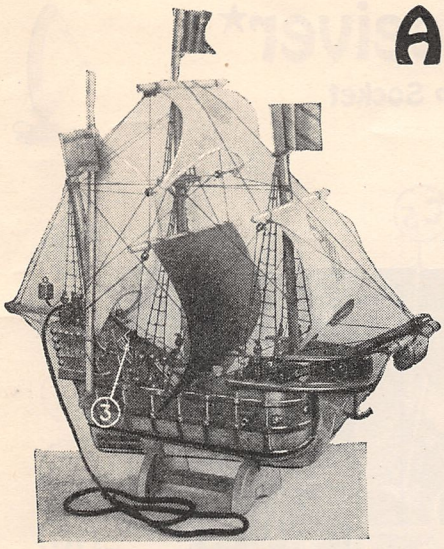
cludes the power transformer, the two filter chokes and the buffer condensers, is mounted on the left side and close to the panel. Directly behind the power compact are mounted the four fixed condensers which compose the condenser block. Three of these condensers have a capacity of 4 mf. each, while the fourth has a capacity of 2 mf. This last one is furthest away from the panel and is connected in parallel with the third 4-mf. condenser to make a total capacity of 6 mf. The battery charger CH, which in this case

(*Continued on page* 1264)

A Ship-Model Loud Speaker

How a Decorative Loud Speaker Can Be Easily Made

By JAMES FRANCIS CLEMENGER



The loud-speaking ship completed.

MANY ingenious attempts have been essayed by ambitious manufacturers, to make the very necessary loud speaker slightly more decorative than it has been in the past. Loud speakers vary in color, shape, and size within very wide limits, the general tendency being toward better reproduction even at the cost of an ungainly appearance.

The usual method of decorating a loud speaker is an attempt to hide its mechanical purpose, by disguising it as something which it most assuredly is not. Every one has seen these instruments built into flower stands, bird cages, fish bowls, and innumerable other peculiar housings; but it is rather hard to find a properly designed speaker which is decorative without being simply an apologetically disguised mechanism.

It occurred to the writer some weeks ago that it might be a good idea to combine the latest of fads in household ornaments with an efficient reproducing unit, to afford a most pleasing appearance with the highest degree of satisfactory reproduction. Ship models are undoubtedly the rage of the present season, as far as interior decorating goes. They are to be found in all sizes and types, from the tiniest silver galleons to huge models of ocean-going liners.

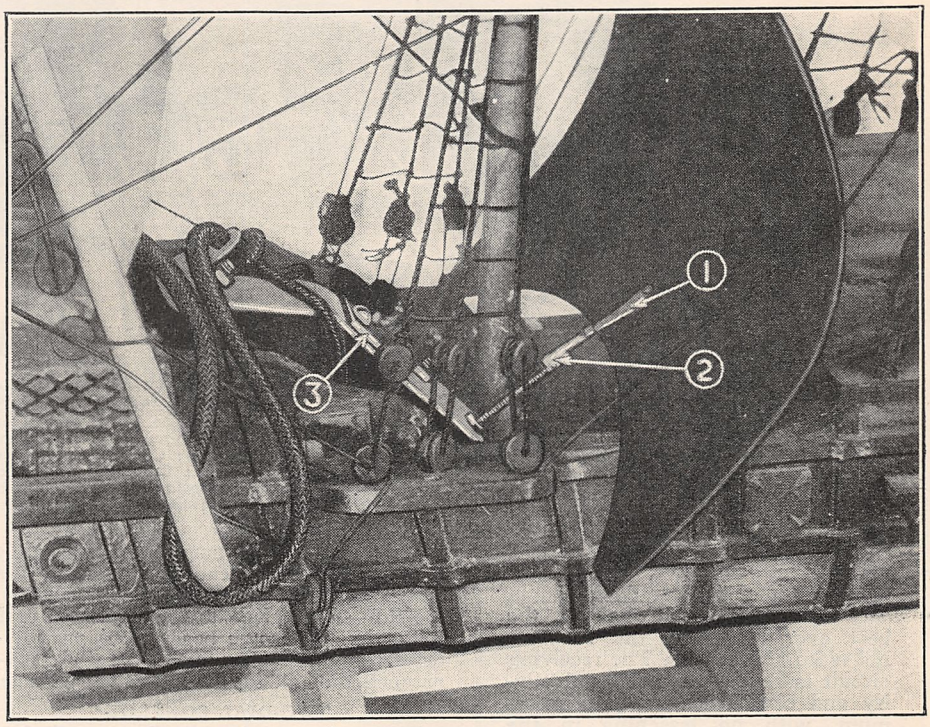
The great majority of the models found in modern homes are quite modest and unpretentious. They are used more for their significance and decorative value than because of their intrinsic worth. In fact, probably two-thirds of the models which are now gracing the mantelpieces of thousands of homes were built by the owners from parts furnished by the "model ship" factories which specialize in such materials.

THE MUSICAL SAIL

Obviously an ideal thing to do would be to incorporate a loud speaker in some way in the design of a model ship, doing away with the cone or horn, and replacing it with a handsome and graceful miniature vessel. Several ideas suggested themselves but it soon became apparent that the only method which would answer was that involving the use of some sort of speaker unit, so connected to one of the sails that it would cause the sail to vibrate and set the air in motion.

Utilizing the principle devised by Clyde J. Fitch, of driving a speaking surface along the length of the paper fibers, through the impulse of a special type of unit, the writer developed the sail speaker pictured here. As may be seen by consulting the illustrations, the driving pin of the loud speaker unit is clamped tight to the edge of the sail surface—which is made of any standard cone-speaker fabric—and the motion of the armature causes the entire sail area to vibrate strongly. In this particular case, as the model was entirely experimental, the only changes made in the ship were to replace the largest sail with a duplicate made of the heavy diaphragm paper, and to cut

(*Continued on page* 1289)



Showing a close-up of the unit as installed: 1, metal plate attaching driving-rod to sail; 2, link; 3, loud-speaker unit.

Photo courtesy of Miniature Ship Models, Inc., and Engineers Service Co.

$300.00 PRIZE SET BUILDING COMPETITION

The Best Superregenerative Receivers Will Win Prize

IN perusing average radio literature, one becomes impressed with the idea that the modern radio receivers, as, for instance, the superheterodyne, and the excellent tuned-radio-frequency receiver, are the most sensitive that it is possible to construct. The radio experimenter knows better, and realizes that the peer of them all is the superregenerator, first devised by Major Armstrong.

The superregenerative circuit is far more sensitive than the superheterodyne, and in some cases its sensitivity reaches such a stage that it becomes incredible. The difficult part with the superregenerative, however, is that it has so far been rather unstable. Superregenerating sets built with the Armstrong, Flewelling and Muhleman Autoplex, as well as other similar circuits, will sometimes do wonders, but often not.

Exactly what takes place in these circuits is not fully known today, because the same result frequently cannot be obtained twice in succession. Superregenerators, in other words, are "tricky." Nevertheless, some time in the future, the Superregenerator will come to the fore again and, when it does, the present-day sets will probably become obsolete. All this, of course, belongs to the future, but it is RADIO NEWS' duty to help the work along and stimulate interest in this extraordinary circuit.

The Prizes

First Prize	$100.00
Second Prize	75.00
Third Prize	50.00
Fourth Prize	25.00
Fifth Prize	15.00
Sixth Prize	10.00
7th, 8th, 9th, 10th and 11th Prizes, $5.00 each	25.00
	$300.00

In the first place, a good Superregenerator gives practically loud-speaker volume on a single tube, for local stations; and, by using two tubes in correct fashion, it becomes possible to get DX stations on the loud speaker as well.

But few parts are needed for such a circuit, which immediately makes the circuit attractive in portable form.

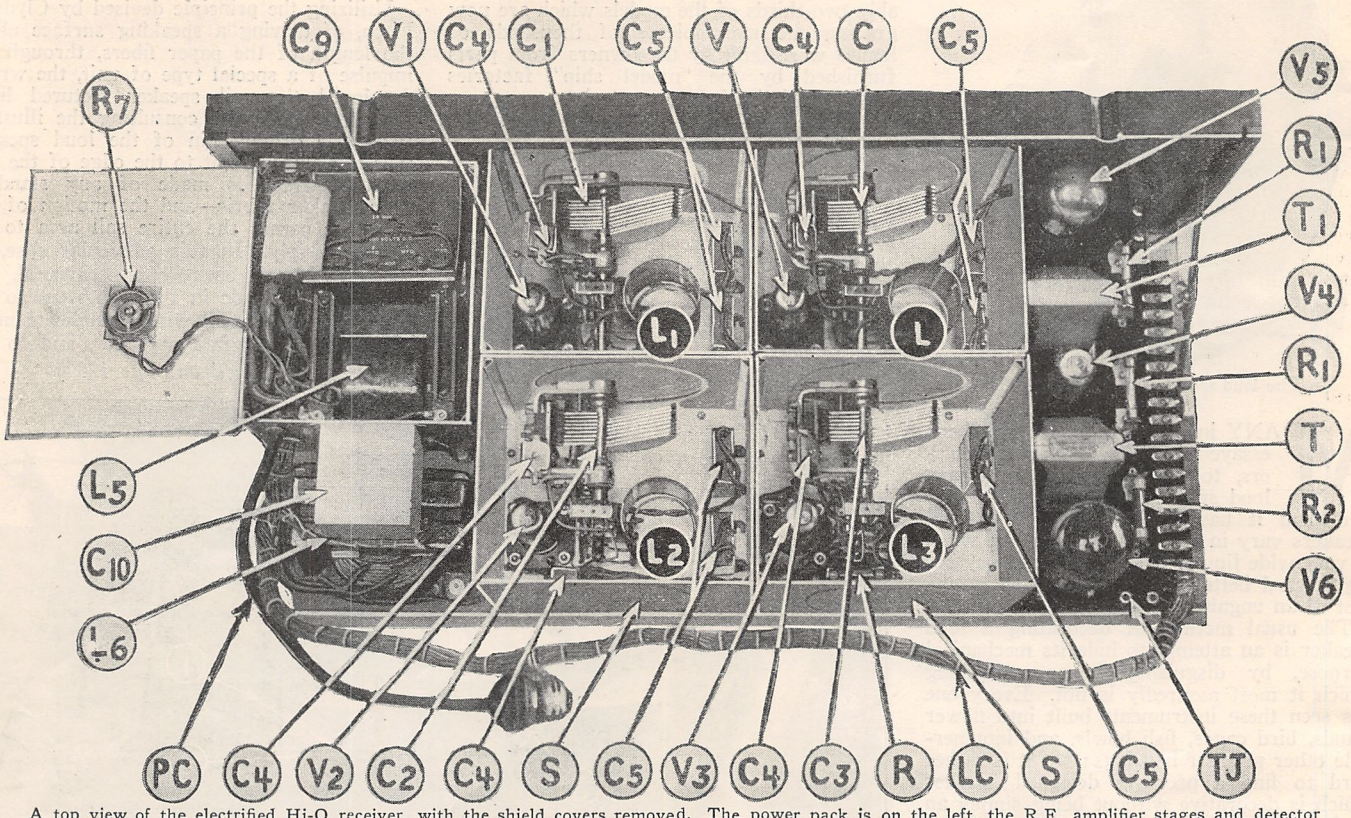
Not much has been printed in the radio literature during the past few years on Superregenerative sets, and RADIO NEWS feels that it is about time that the subject should come to the fore again.

(*Continued on page* 1275)

The Electrified Hi-Q Receiver*

A Set Which Operates Directly from the Lamp Socket

By ALGER S. RIGGS†



A top view of the electrified Hi-Q receiver, with the shield covers removed. The power pack is on the left, the R.F. amplifier stages and detector in the center, and the A.F. amplifier on the right. The parts in the receiver proper are: L, antenna coupler; L1, L2 and L3, R.F. transformers; C, C1, C2 and C3, the variable tuning condensers; C4, balancing condensers; C5, by-pass condensers; V, V1 and V2, R.F. tubes; V3, detector tube; and R, grid leak. In the power pack, R7 is the line-voltage regulator; C9, condenser bank; C10, output filter condenser; L5, filter choke and L6, power transformer. On the audio panel T and T1 are the A.F. transformers; R1 and R2, fixed resistors for voltage regulation; V4, first A.F. tube; V5, power tube; and V6 rectifier tube.

THE radio receiver described in this article is one of the best ever tested in the RADIO NEWS Laboratories. The receiving circuit is so designed that selectivity and sensitivity are at a maximum, with no lessening in the quality of reproduction. The power-supply portion of the set is well designed also, as no appreciable 60-cycle hum is present in the loud speaker.

There are many excellent features incorporated in this Hammarlund-Roberts Hi-Q Electrified receiver, which will be apparent upon inspection of the illustration. The system of shielding employed, for instance, is complete in every detail, and the entire receiver is one that should give pleasure to any constructor, whether he be purely a DX fan or an enthusiast for good music.—EDITOR.

THE average broadcast listener today demands of his radio set first, that it give him perfect tone quality with ample selectivity, and second, that its operation be simple and the attention required to maintain it in operating condition be an absolute minimum. If his set satisfies these requirements, the possibility of dependable distance reception may then be considered.

With this in mind, the Electrified Hammarlund Hi-Q has been designed and constructed. Utilizing three tuned-radio-frequency stages, it is amply sensitive, while selective enough to cut through the locals with ease. The auto-couple coils used in the R.F. stages give equal amplification over the entire wavelength band, and a properly-designed audio system makes for perfect reproduction of all tones in the audible range.

TWO-DIAL CONTROL

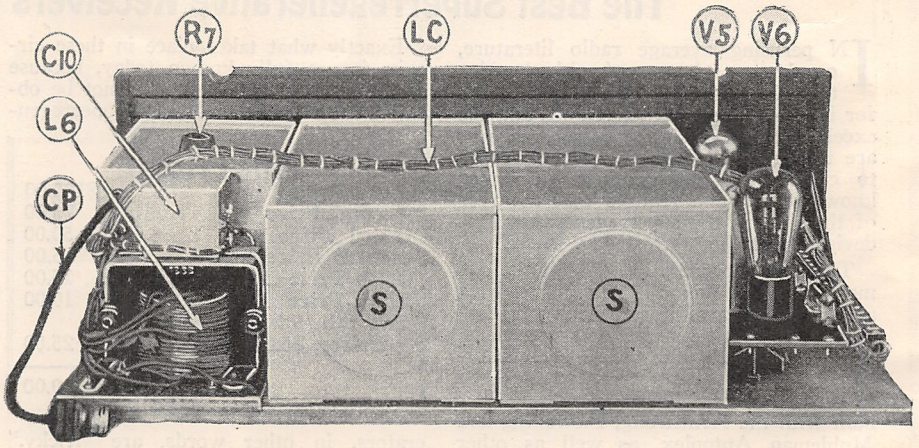
The method of "ganging" the radio-frequency stages is rather unique, the first radio stage being coupled mechanically by a common condenser shaft to the detector stage. As the first stage is usually fairly broad, even on distant stations, the satisfactory alignment of this stage with the detector stage is quite possible. As the coupling to the antenna circuit is rather loose, variation in the length of the antenna used is easily compensated by adjusting the equalizer on the detector stage.

The second and third radio stages also are mechanically coupled and, in these more sharply tuned stages, absolutely perfect alignment is possible, as the input and output circuits of the two stages are identical.

All R.F. stages are individually shielded in accordance with the best practice, and the R.F. currents are carefully by-passed in each shielded compartment, to prevent interstage coupling through external leads.

QUIET OPERATION ON A.C.

The audio system approaches as close to perfection as is possible at the present time. In spite of complete A.C. operation (without



A rear view of the completed receiver. CP is the cable and plug for connecting the set to the lamp socket. LC is the line cable connecting the power pack with the receiver and amplifier. S are the aluminum shields. The units are mounted on a wooden baseboard, which is supported by heavy brackets.

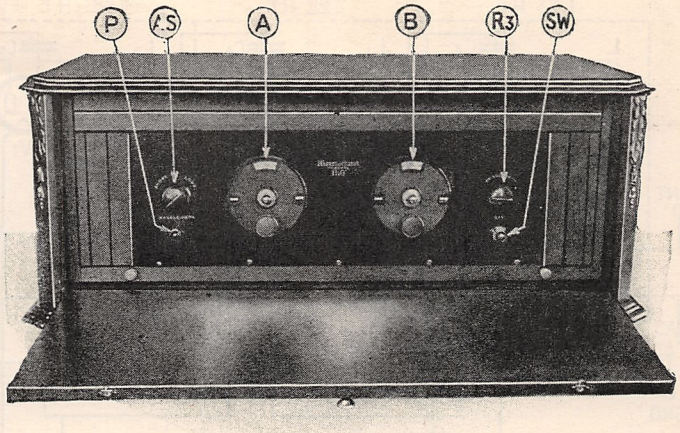
* RADIO NEWS *Blueprint Article No. 15.*

†*Chief Engineer, Rossiter, Tyler & McDonell, Inc.*

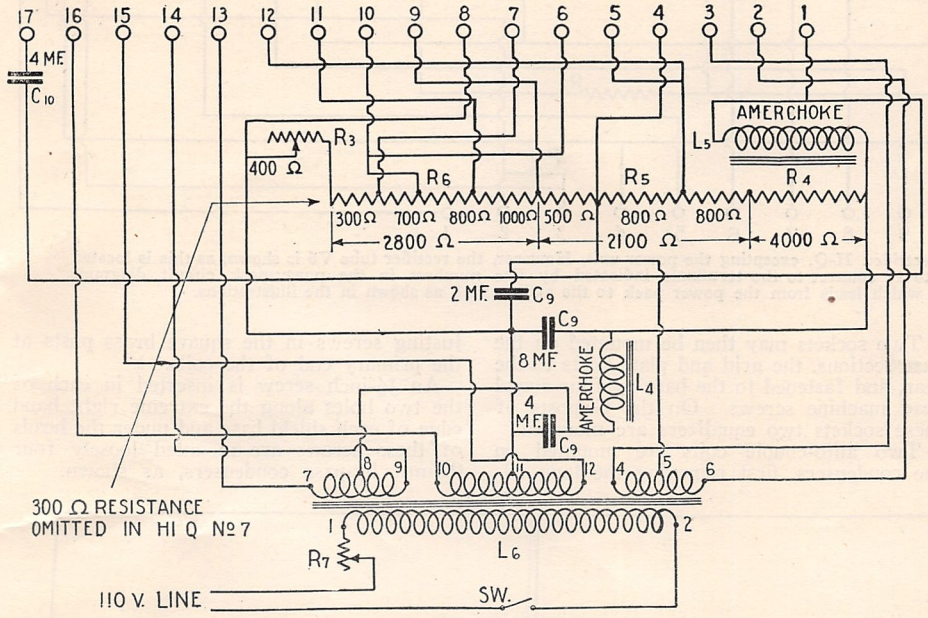
trickle chargers, liquids, or other undesirable features), the set is as quiet in operation as a battery set, and no hum can be noticed even a few feet from the loud speaker. The A.C. operation also reduces the attention required by the set to an absolute minimum and the owner knows that his set may be depended upon at all times for reliable reception, at the turn of a switch.

Tubes of the 199 type are used throughout the set, except for the power tube in the last audio stage and the full-wave rectifier tube. Regardless of the line voltage, the voltage on the tubes may be adjusted to the proper value for effective operation by means of a convenient line compensator mounted on the power pack.

The construction of this set may be safely attempted by the average radio fan with the expectation that he will experience little difficulty in completing the assembly and putting the set in operation.



A front view of the electrified Hi-Q receiver in its cabinet. It will be noted that the cabinet has a front cover which, when closed, conceals the panel of the receiver. A and B are the main tuning dials, each of which controls two condensers. AS is the aerial switch, P the pilot light, R3 the volume control and SW the switch which turns on and off the whole set.



The schematic circuit diagram of the complete power-pack unit. In comparing this with the picture wiring diagram, on page 1235, it will be seen that the numbers from 1 to 17 are equivalent to the corresponding numbers on each wire and that the numbers on the power transformer windings (L6) are also identical. The resistance bank is seen to be composed of three units, R4, R5 and R6. All three are connected in series with the taps taken off at definite points. The 2-mf., 4-mf., and 8-mf. fixed condensers are all contained in the condenser bank C9.

The following instructions, together with the accompanying pictures and detailed diagrams, are all that the builder will require in order to construct the Hi-Q Electric Eight.

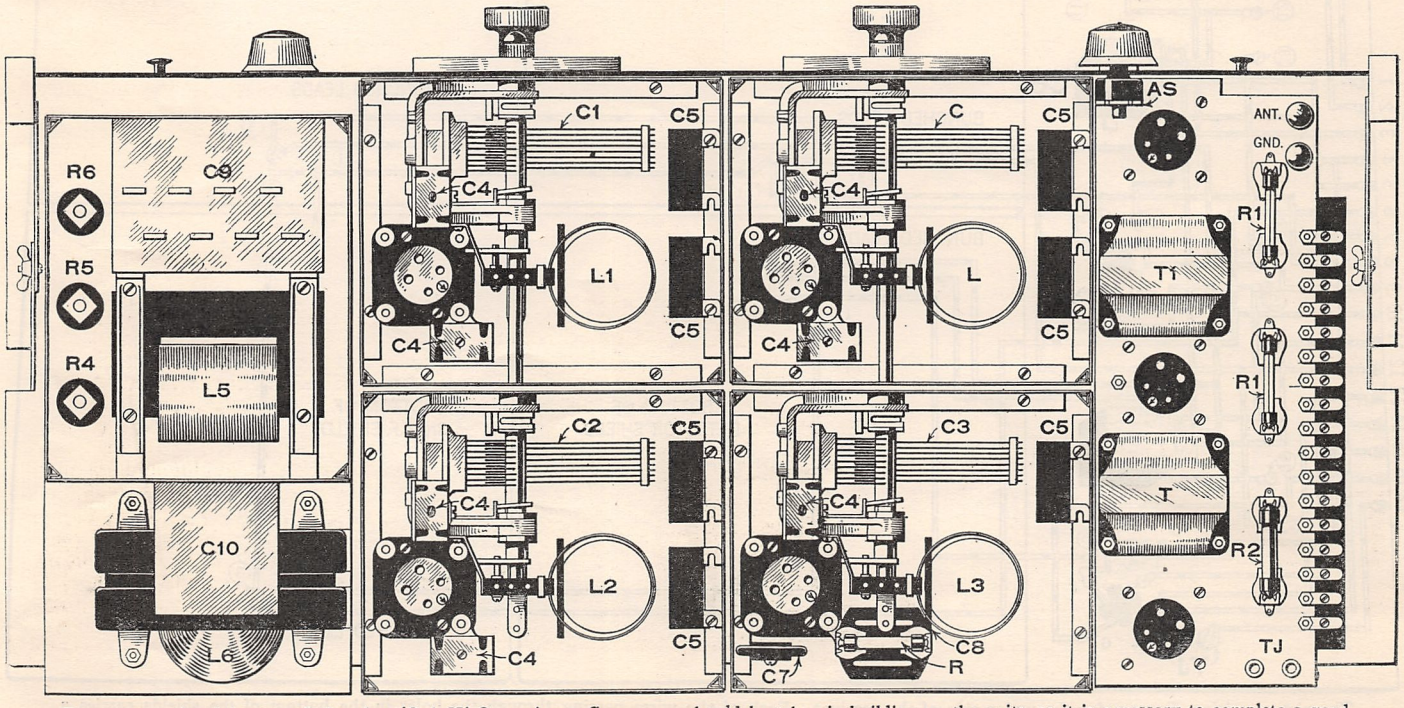
CONSTRUCTION OF RADIO UNIT

The various parts should first be assembled on the panel. In the lower right hand hole mount the battery switch, SW, and directly above this, the 400-ohm potentiometer, R3. In the lower left hand hole is mounted the pilot light, P, in a horizontal position, and above it the aerial switch, AS.

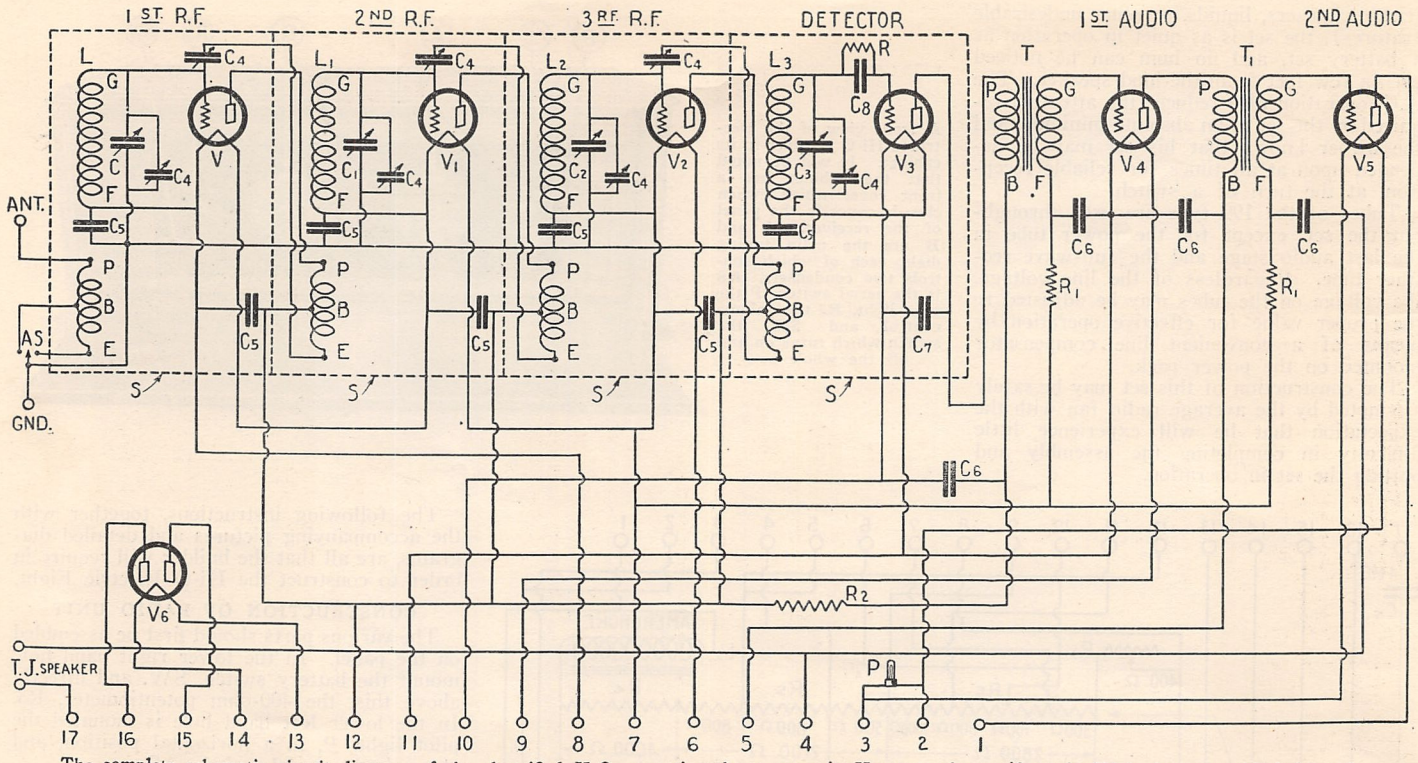
The short shafts should be removed from .000375-mf. S.L.F. condensers, C, C1, C2 and C3, the single-hole-mounting nuts discarded, and the screws on the friction band brakes loosened until the condensers turn very freely.

Two of the condensers are now mounted on the front panel, placing an A shield section between each condenser and the panel. It will then be necessary to drill through the shields with a No. 27 drill to insert the dial set pins. The holes in the panel may be used as a guide for this purpose.

Three E or bottom shield sections are now placed on top of each other, in the position in which they will be located in the finished set, and 5/16-inch hole drilled through them, 3½ inches from one end and ⅝ inch from the edge. The fourth section is drilled with the same size hole, but 1 inch from the edge. See layout on page 1234.



The constructional layout of the electrified Hi-Q receiver. Great care should be taken in building up the units, as it is necessary to complete a good part of the actual wiring before all the sides of the shields are put in place. Full instructions are given in the article. The knob on the left-hand side of the panel is the volume control R3. All the drilling details are given in the drawings on page 1234.



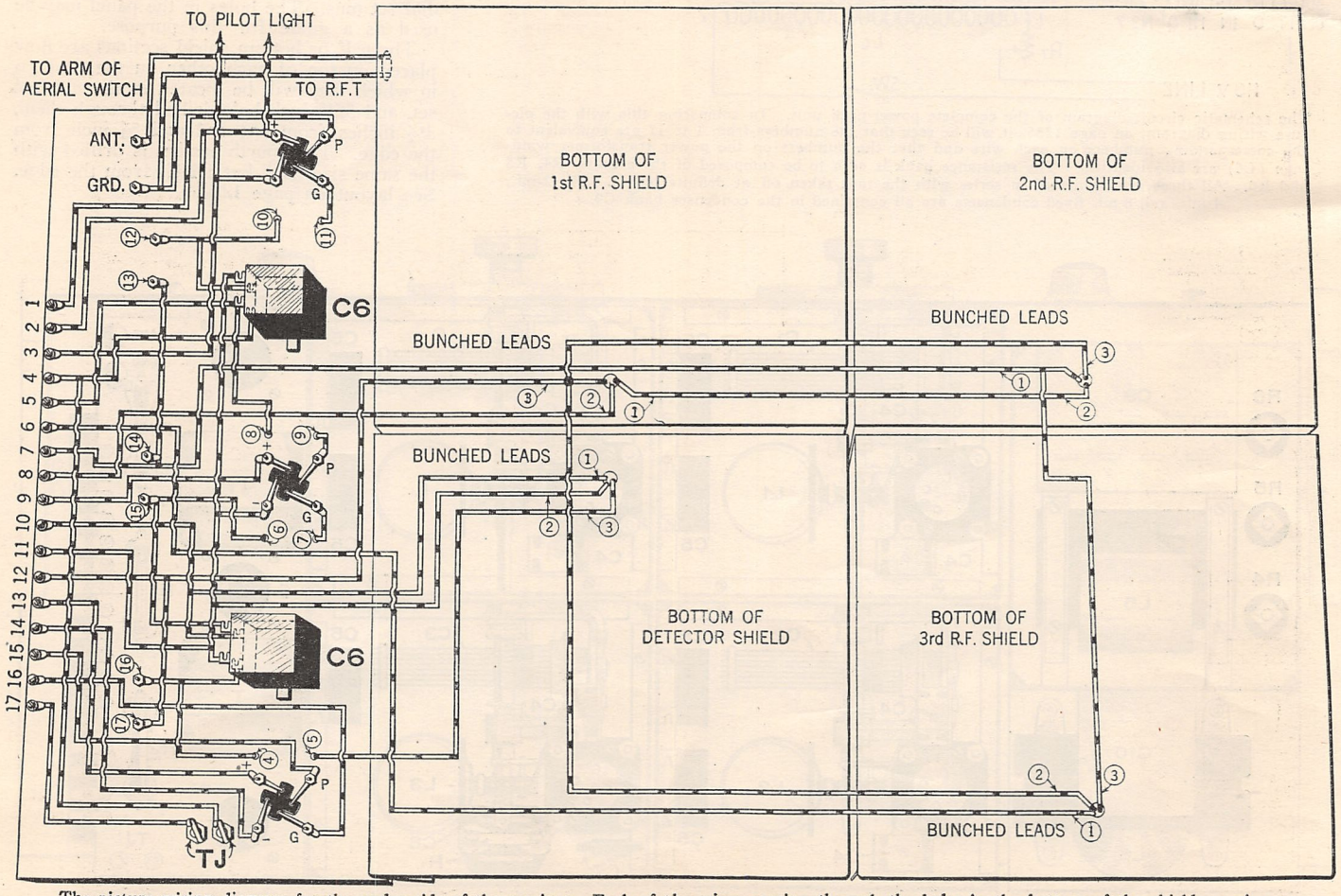
The complete schematic circuit diagram of the electrified H-Q, excepting the power unit. However, the rectifier tube V6 is shown, as this is located on the audio sub-panel. The terminals marked 1 to 17 connect to the terminals indicated by like numbers in the power-pack circuit diagram. Actually, there is a line cable (LC) which leads from the power pack to the audio panel, as shown in the illustrations.

Four of the aluminum base strips are slid into position, two of the E sections placed on top of them but under the lips of the panel shield sections, and the assembly fastened together with screws passing through the lips of the A shield sections and into the threaded holes in the strips.

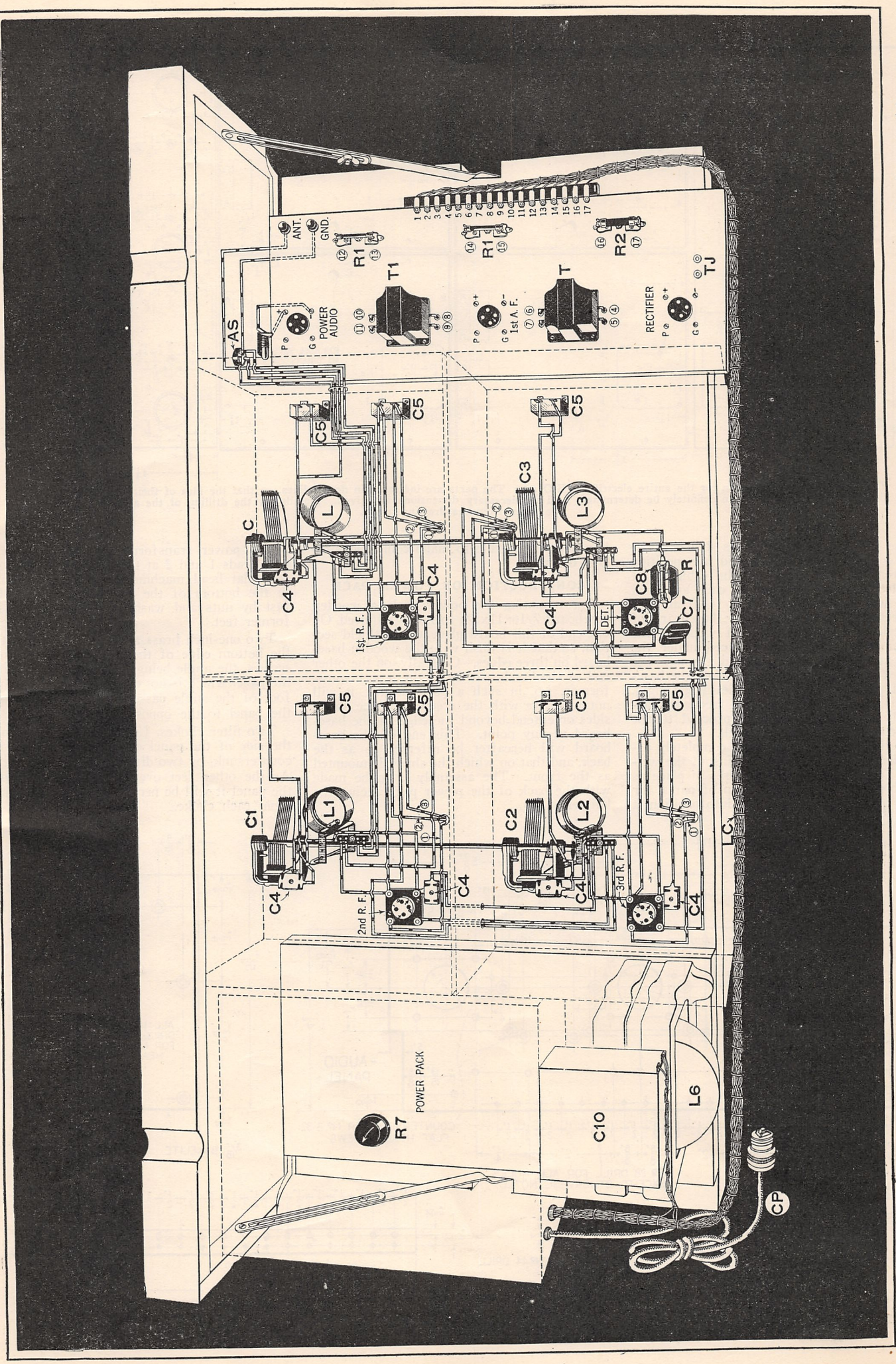
Two sockets may then be mounted on the base sections, the grid and plate posts to the rear, and fastened to the base by four round head machine screws. On the G posts of these sockets two equalizers are mounted.

Two auto-couple coils are mounted on the condensers, first removing the long adjusting screws in the square brass posts at the primary end of the coils.

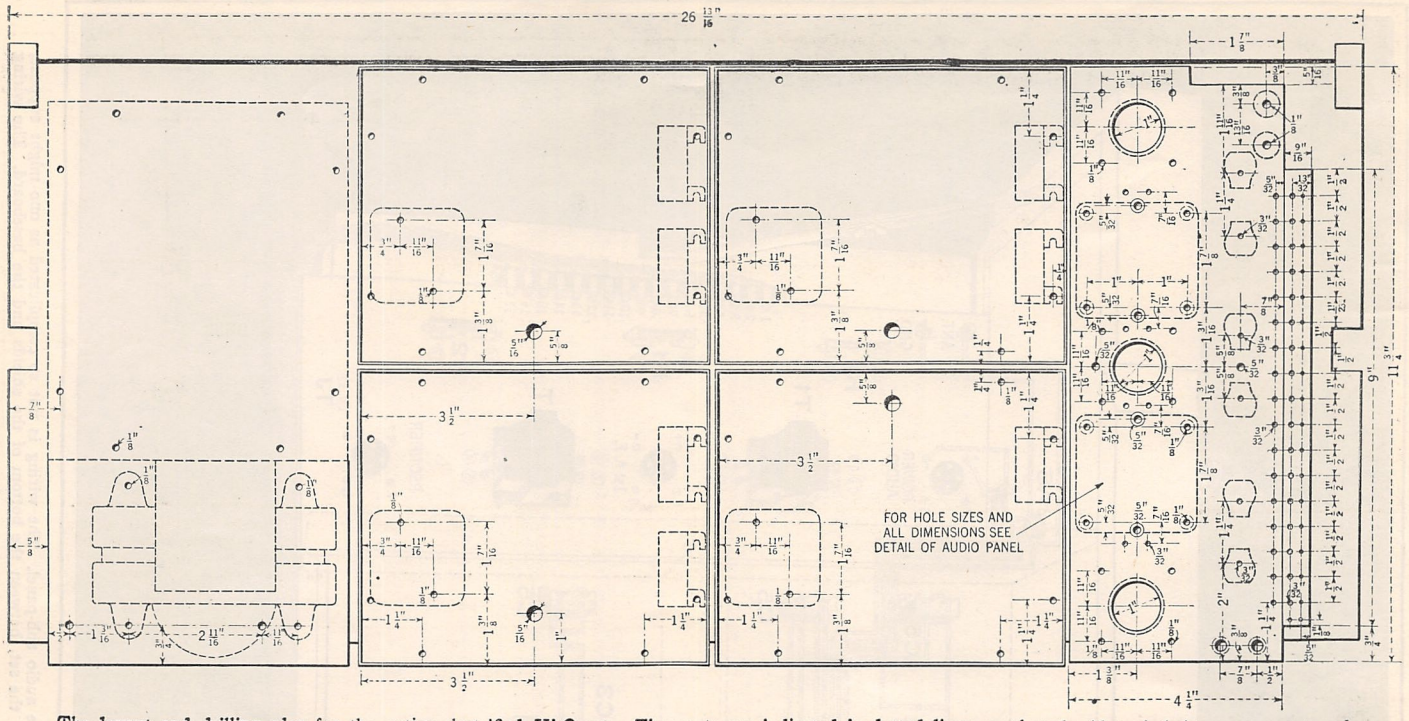
An 1/8-inch screw is inserted in each of the two holes along the extreme right hand edge of each shield base and under the heads of these screws are mounted loosely four 0.5-mf. by-pass condensers, as shown.



The picture wiring diagram for the under side of the receiver. Each of the wires passing through the holes in the bottom of the shields carries a number, identical with that given for the same number in the diagram of the upper side. C6 are the A.F. by-pass condensers. The terminals marked 1 to 17 connect to the terminal strip carrying the line cable from the power pack.



The picture wiring plan for the upper part of the electrified Hi-Q. Note the line cable (LC) which terminates at the connector strip on the audio sub-panel. The wiring is not so complicated as one might suppose, as the connections in each stage are practically identical. In each shield are three wires which pass through a hole to the under part of the set, between the bottom of the shields and the baseboard. The wiring for the power pack is shown on page 1235.



The layout and drilling plan for the entire electrified Hi-Q set. The parts are indicated in dotted lines, so that the idea of their arrangement and the purpose of each hole can definitely be determined. All the necessary dimensions are given. Details for the drilling of the audio panel should be taken from the drawing below.

The R.F. assembly, wired as shown in the very complete diagrams, is slid into position between the side strips of the cabinet. It will be found that when the cans are level there will be approximately 5/16 of an inch between their bottoms and the baseboard of the cabinet. Small blocks of wood of the proper thickness may be placed under the cans and wood screws passed through the base of the cans and the blocks into the baseboard to make the assembly level and rigid.

This completes the radio frequency assembly and the builder can proceed to the construction of the power pack.

Do not wait until you have completely assembled the parts before you install the wiring. Instead, run as many wires in place as possible as you mount a group of parts, for after all the shields are slid into position it is almost impossible to make connections inside them.

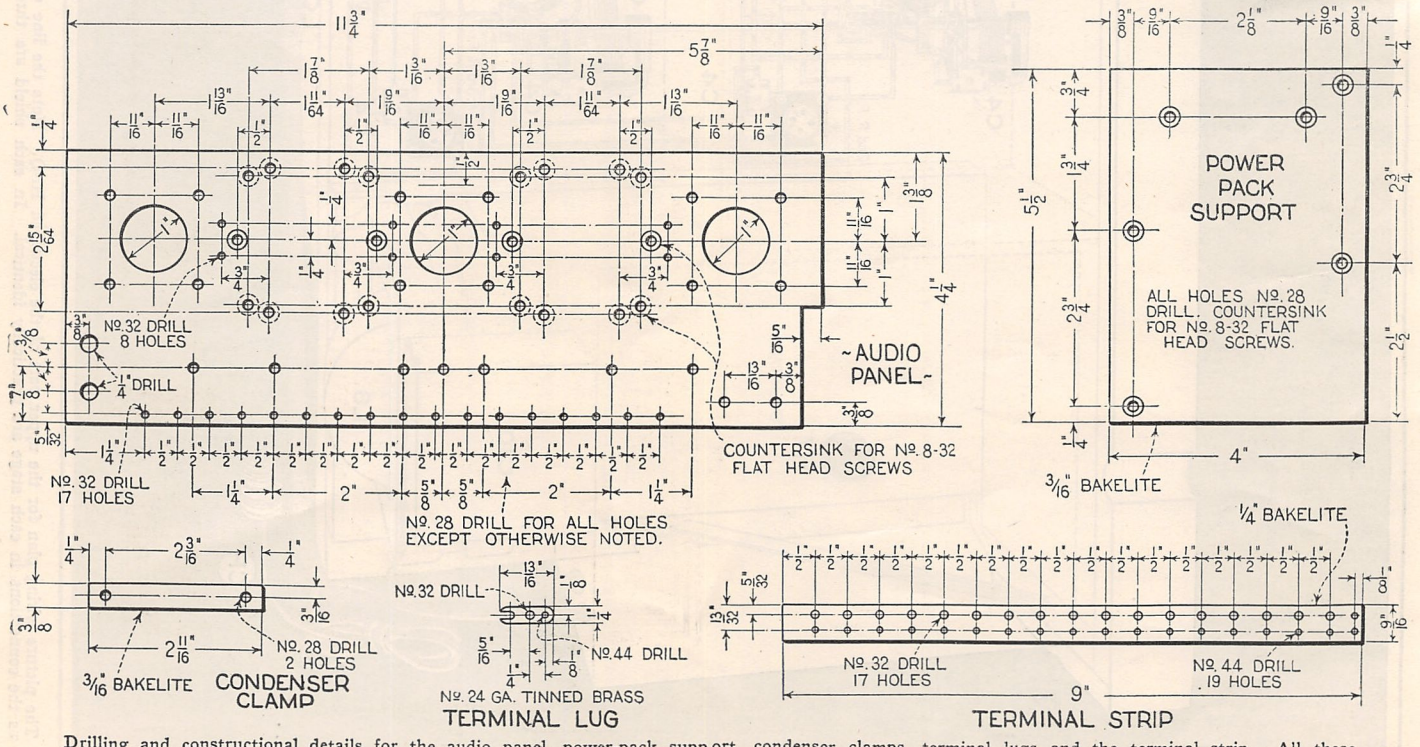
CONSTRUCTION OF POWER PACK

For mounting the power pack, a wooden baseboard 7/16x11x5⅞ inches is required. On one end of this board place a base shield section, so that it is flush with the wooden baseboard on three edges. Centrally, on the other end of the baseboard locate the power transformer, L6, in such a position that it will not interfere with the erection of the shield sides or extend beyond the edge of the baseboard at any point. This end of the baseboard will hereafter be referred to as the back, and that on which the shield is mounted as the front. The assembly is to be made with the back of the power pack facing the builder.

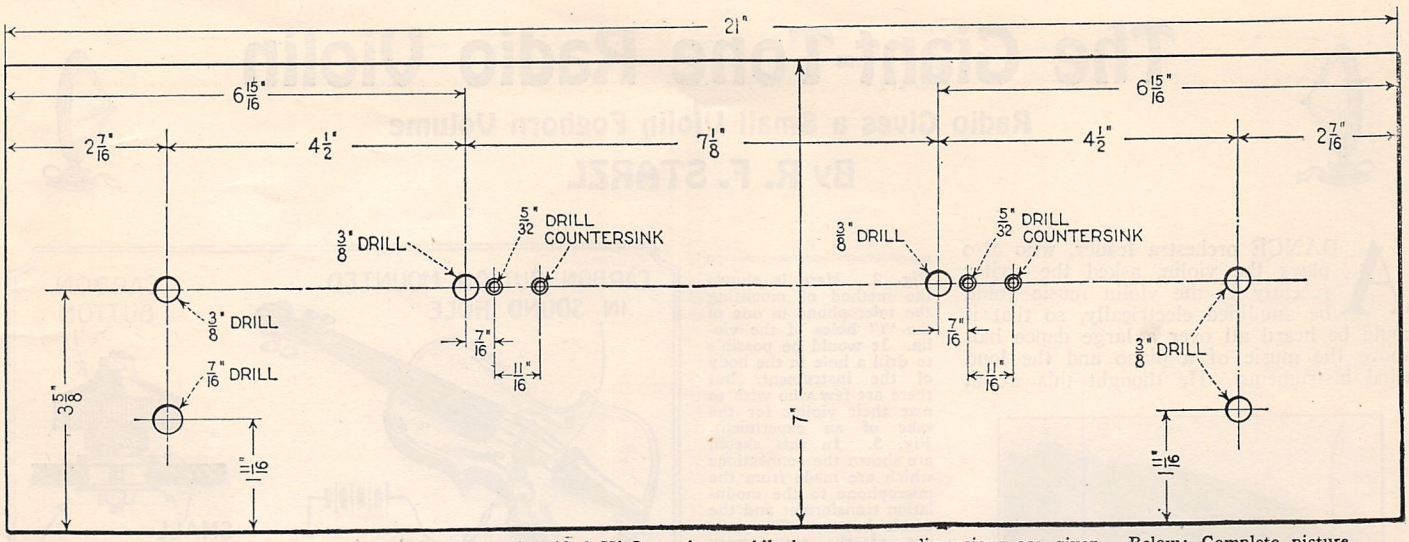
The power transformer is now mounted with leads 1 and 2 at the back, by means of four flat head machine screws countersunk in the bottom of the baseboard, and made fast by nuts and washers above the transformer feet.

Two one-inch brass angles are fastened to the bottom edge of the panel with machine screws, the angle being bolted to the side of the panel which is not countersunk, while the foot of the angle passes across the edge of the panel to the opposite side.

Two filter chokes, L4-L5, are mounted on the side of the panel opposite that which is countersunk, by two diagonally opposite feet. As the other feet overlap at the center of the panel it will be necessary to saw off one from each choke.



Drilling and constructional details for the audio panel, power-pack support, condenser clamps, terminal lugs and the terminal strip. All these parts are made from high-insulating material: with the exception of the terminal lugs, which are brass.



Above: Drilling details for the front panel of the electrified Hi-Q receiver. All the necessary dimensions are given. Below: Complete picture wiring plan for the power pack unit. The numbers in circles refer to those on the terminals of the power transformer L6. All other numbers refer to the line-cable reference numbers on the audio panel terminal strip. In wiring up the power pack it is particularly desirable to color each lead in this drawing with crayon, as the wire is connected up in the unit, until all leads are accounted for. Otherwise you may make a mistake.

The baseboard is placed with the power transformer toward the builder, and the shield face at the front end of the baseboard is temporarily set in position. A 7/16-inch hole is to be drilled in this shield section, ¾-inch from the top edge, and ¾-inch from the left-hand side, as the shield now faces the builder. An ⅛-inch socket bushing is inserted and fastened on the inside with a lock nut. This shield section may now be permanently screwed in place with wood screws passing through the holes in the shield base into the baseboard.

The condenser block, C9, is now placed vertically in the front right-hand corner of the shield, against the front wall, but so that it will clear the right-hand wall of the shield by ¼ inch.

The panel on which the chokes are mounted is now placed against the back side of the condenser block, the brass angles passing under the block, and the sides of the block flush with the sides of the bakelite panel. The block is then lifted out vertically, and the brass angles screwed to the base with wood screws, after first drilling through the aluminum base section.

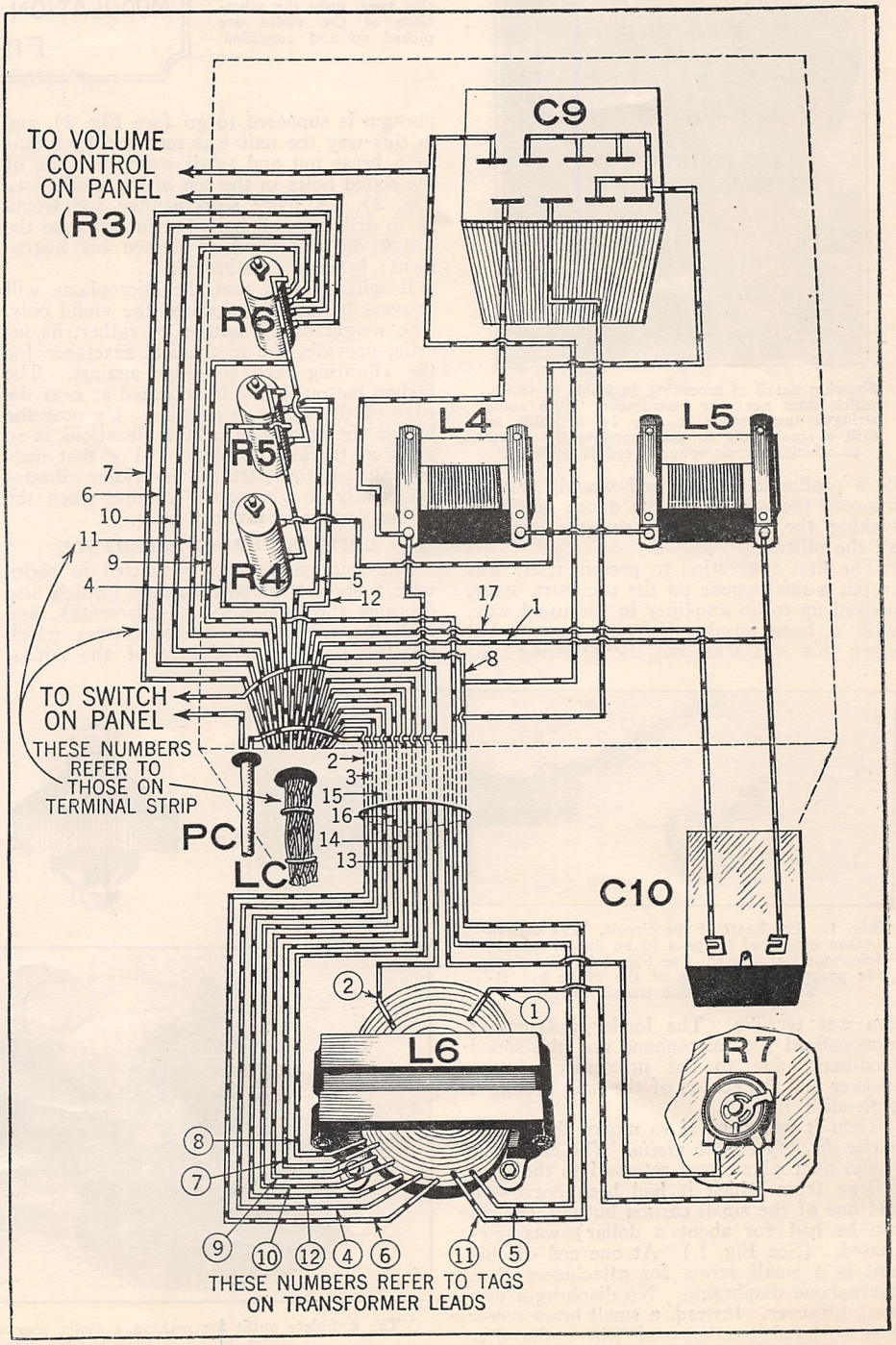
The block is then replaced and mounted by means of two brass angles soldered to its case; one to the lower left hand side and fastened to the base with another wood screw. The other angle is soldered, three-quarters up the right-hand side, in such a manner that it extends across the back side of the panel between the legs of the upper choke, and thus clamps the condenser block to the panel. The right-hand shield section may now be fastened in place.

The rear shield section is to be drilled as follows before inserting: a vertical line is scribed on this section, ¾-inch from the left side. Measuring down on this line, ¾-inch from the top, a 7/16-inch hole is drilled. A 11/16-inch hole is then drilled, 1½ inches from the top, and another one the same distance from the bottom along the same center line. The smaller hole is bushed with a ⅛-inch socket bushing and lock nut, while the two larger holes are bushed with ⅜-inch socket bushings and lock nuts. This shield section may now be mounted in place.

Two 1-inch brass straight angles are soldered to the opposite ends of the base of the 4-mf. condenser, C10, extending half their length beyond the base, thus forming mounting feet. The condenser is then mounted against the back wall of the shield by means of machine screws, its side resting on the top of the power transformer with the condenser terminals to the right.

The three resistances, R4, R5 and R6, are now mounted vertically along the left-hand

(*Continued on page* 1268)

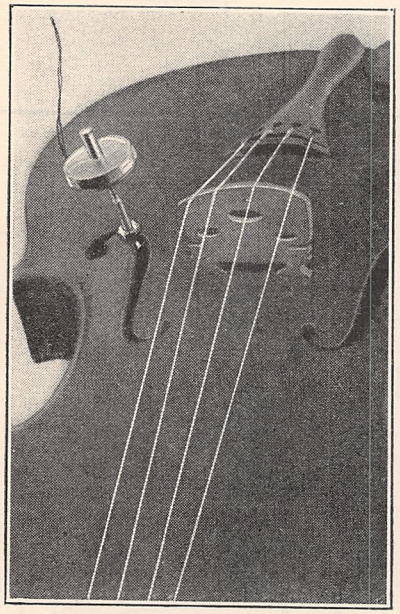


The Giant-Tone Radio Violin

Radio Gives a Small Violin Foghorn Volume

By R. F. STARZL

A DANCE orchestra leader, who also plays the violin, asked the writer recently if the violin music could be amplified electrically, so that it could be heard all over a large dance hall above the music of a piano and the loud wind instruments. He thought this would



Showing detail of mounting in f-hole of violin, which does not mar instrument. With some stringed instruments it may be desirable to drill a small hole to accommodate the screw to which the microphone reed is soldered.

be a profitable novelty and would, as well, improve the quality of the dance music by making the director's instrument dominate all the others.

The first suggestion to present itself was to put a microphone on the orchestra stage, hooked up to an amplifier in the usual way, with a horn speaker for the output, but when this was tried out the resulting bedlam was terrible. The louder instruments monopolized the microphone and the sound feed-back, due to the proximity of the speaker and the echoes of the hall, produced a fiendish howl.

Then it was decided to mount the microphone *directly on the violin*. The expensive studio microphone was returned to the local college from which it had been borrowed, and one of the small carbon buttons (which can be had for about a dollar) was purchased. (See Fig. 1.) At one end of this unit is a small screw for attachment to a microphone diaphragm. No diaphragm was used, however. Instead, a small brass screw was soldered to the reed where the diaphragm is supposed to go (see Fig. 2), and in this way the unit was mounted by means of a brass nut and small washer in one of the sound holes in the top of the violin (see Fig. 3). A more workmanlike job would be to drill a small hole, but in this case the owner did not want to deface his instrument; hence the makeshift.

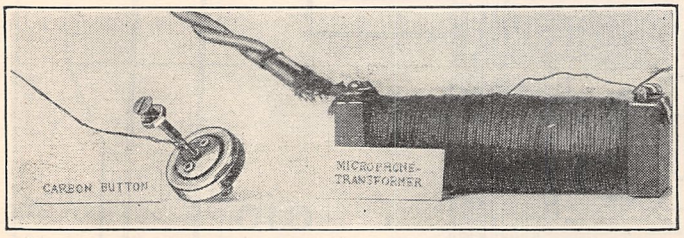
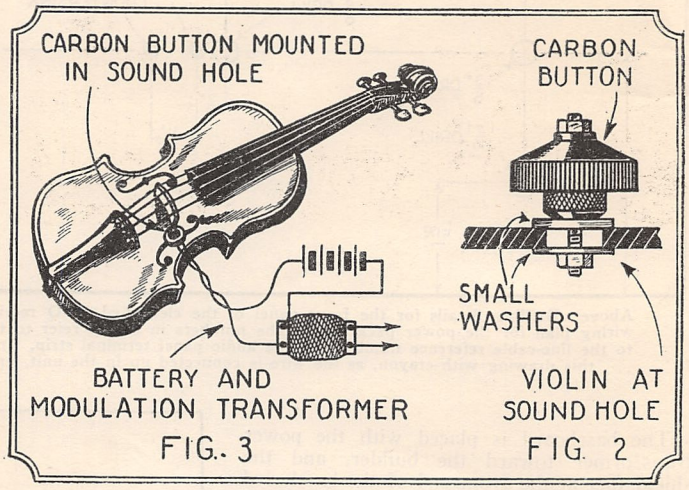


Fig. 1. The heart of the circuit. The carbon button employed happens to be out of an old telephone transmitter. See Fig. 4 for directions for progressive winding of the crude but efficient microphone transformer.

Fig. 2. Here is shown the method of mounting the microphone in one of the "f" holes of the violin. It would be possible to drill a hole in the body of the instrument, but there are few who wish to mar their violins for the sake of an experiment. Fig. 3. In this sketch are shown the connections which are made from the microphone to the modulation transformer and the 6-volt battery. The output of the transformer goes to the audio-frequency amplifier, two circuits for such amplifiers being given on page 1262. By using a microphone of this type, only the vibrations of the violin are picked up and amplified.



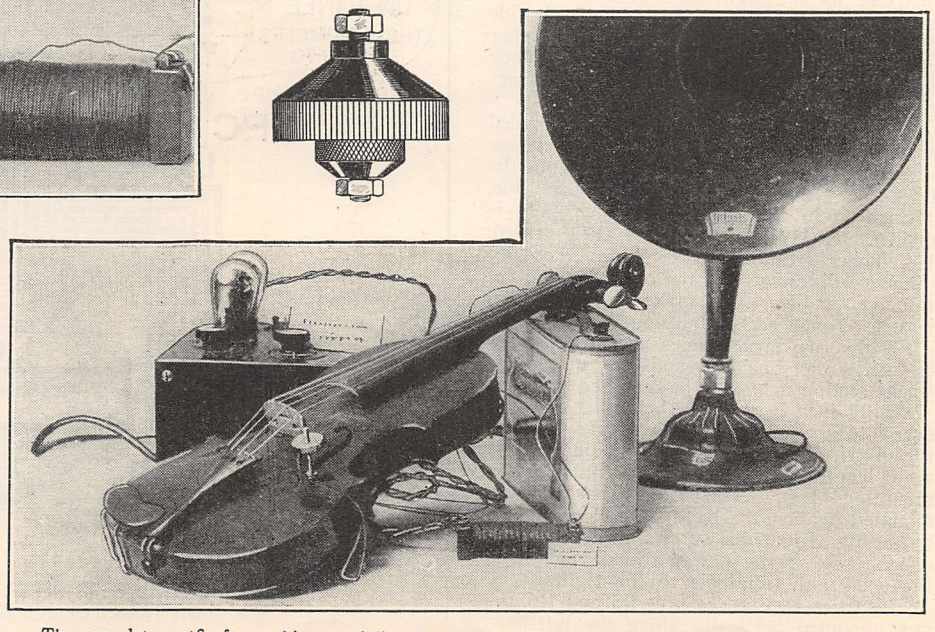
It will be seen that the microphone will respond to the vibrations of the violin only. The weight of the button, or rather, its inertia, provides the mechanical reactance for the vibrating reed to work against. The carbon button should be mounted as near the edge of the violin as possible. Up near the bridge the amplitude of the vibrations is so great as to cause distortion. For that matter, almost any part of the violin vibrates sufficiently to give good volume when the carbon button is fastened to it.

BUILDING UP AN IMPEDANCE

The microphone was connected in series with a six-volt storage battery (which also operates the amplifier-tube filaments), and with the primary of a transformer which matches the low impedance of the microphone to the high impedance of the first amplifier tube. Modulation transformers for this purpose can be bought; or a good one can be made out of an ordinary telephone coil, which may usually be had for nothing at the local telephone exchange. The primary of the coil is used "as is." The secondary is brought up to the proper impedance by winding on about 2 or 3 ounces of No. 36 D.S.C. enameled wire (see Fig. 4). The outside end of the secondary (which is wound over the primary) is first uncovered and soldered to the end of the additional wire. The secondary is then covered with insulating tape or empire cloth, for considerable voltage difference will be developed between the two sections.

It would be impossible for anyone not equipped with a winding machine to lay the turns on nice and straight; but for this purpose it is neither necessary nor desirable to do so. A kind of a "jumble-bank-wound" effect is secured instead by winding as shown in the drawings. This is very easy to do. It reduces distributed capacity and simplifies insulation, because the potential be-

(*Continued on page* 1262)

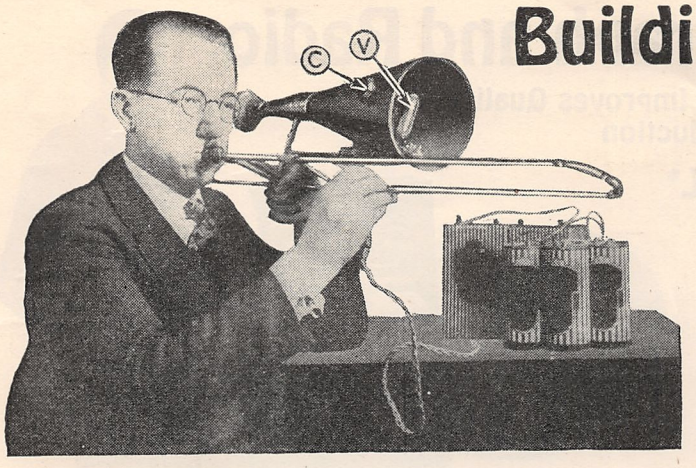


The complete outfit for making a violin play with enormous volume. Above is shown a transmitter button of another type, which can be used instead of that shown.

Building the "Tromborad"

Construction of an Instrument Combining the Trombone and Radio

By G. B. ASHTON



At the left is shown the Tromborad in operation. Within the mouth of the horn may be seen the vacuum tube, V, which is of the 199 type. The control marked C, is a rheostat, by means of which the volume of the horn is governed. The necessary "A" and "B" batteries may be seen to the right.

NO doubt, many readers of RADIO NEWS have followed with attention the article in the December issue, describing the construction of "The Pianorad." Perhaps some of them constructed the one-tube hook-up, as I did. After I had it finished and working I wanted to make a lower-pitch note and, as the instructions stated that to reduce the pitch of the tone an iron core was inserted in the audio windings, I picked up the nearest iron object, which in this case was a pair of shears. As I slid this down into the coil the pitch lowered about an octave and as I pulled the shears out the pitch would rise about an octave. Ah! An idea, The Tromborad! Thus was born the idea of the instrument I am going to tell you how to make.

Most of the materials used in the construction of the Tromborad were parts I had on hand and the rest was purchased from the ten-cent store.

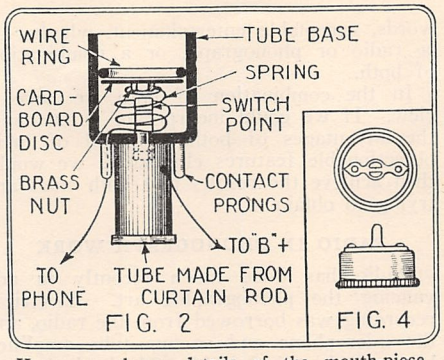
As in the construction of the Pianorad, it is necessary to have the windings from an audio transformer. The iron core is removed. It so happened in my case that the wires to the binding posts on the transformer were long enough to permit the original insulation strip and posts to be bound to the side of the coil and used in this manner.

The slide-trombone part of the Tromborad was constructed from ten-cent curtain rods, the sliding variety. This rod is coated with a resinous lacquer which makes soldering very easy. The general construction of the Tromborad may be seen in Fig. 1. The entire radio part, except the batteries, is included in the trombone. These are connected to three binding posts fastened to the horn part. The horn was made from a card-board megaphone.

The diagram of connections is shown in Fig. 3. You will note that the binding posts of the audio coil are marked. It is very important that these be connected correctly or your instrument will produce no sound.

CONSTRUCTIONAL HINTS

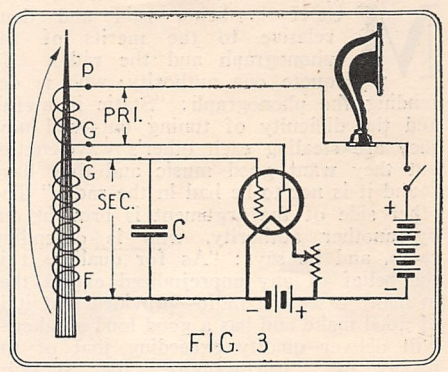
In making the slide part of the Tromborad it is necessary that the rods be exactly parallel. To make them so, drive a nail in a board to hold the rods parallel when soldering the round ends and the cross bars in place.



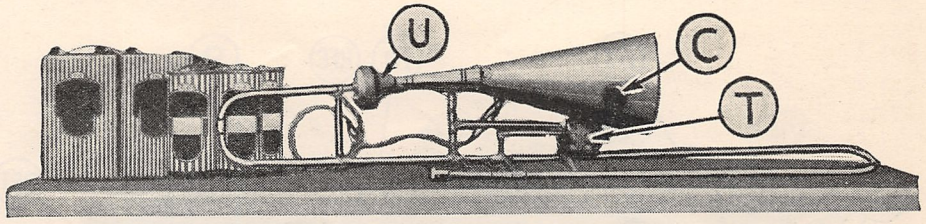
Here are shown details of the mouth-piece switch and, in Fig. 4, the manner in which the unit is attached to the curtain rod.

The mouth-piece switch is shown in detail in Fig. 2. This switch is so constructed that when you blow into it an electrical contact is made, thus causing the tube to oscillate and produce an audible note. This switch is made from the bakelite base of a burnt-out 199 tube. The first thing to do is to remove two of the opposite contact points from the base. Of course the glass and wire left from the broken bulb should be removed. The holes left where the contacts are removed serve as outlets for the air when the mouth piece is blown into.

The spring was made from some wire taken from an old rheostat. It was made into a spiral just large enough at one end to fit into the tube base and tapering down at the other end so it can be soldered to a small brass nut, as shown in the drawing. The large end of the spring is soldered to one of the two remaining contact prongs. A small hole is drilled in the bottom of the old base and a switch point is placed here to act as the other contact. A small disk of card-board is glued to the small nut. A ring of stiff wire is made just the right size to slip snugly into the mouth-piece. This holds the paper disk in place and allows an adjustment of the contacts. They should be adjusted so that there is very little distance between them. In this way only a slight puff is necessary to complete the contact. One of the tips from the curtain rods is soldered to the two base prongs, this tip slipping on the rod as shown in Fig. 1. Be sure that it does not touch the switch point.



The diagram of connections for the "Tromborad." The inductances are the windings of an A.F. transformer.



Above is shown the assembled Tromborad with the necessary dry-cell batteries. The unit, designated by U, is shown in Fig. 4; the control, C, is a rheostat for governing the filament voltage of the 199-type tube, and T shows the position of the audio-frequency transformer, the windings of which are used as shown in Fig. 3. At the left are the constructional details of the Tromborad. Each part of the instrument is plainly designated, so no trouble should be had by the constructor in identifying them.

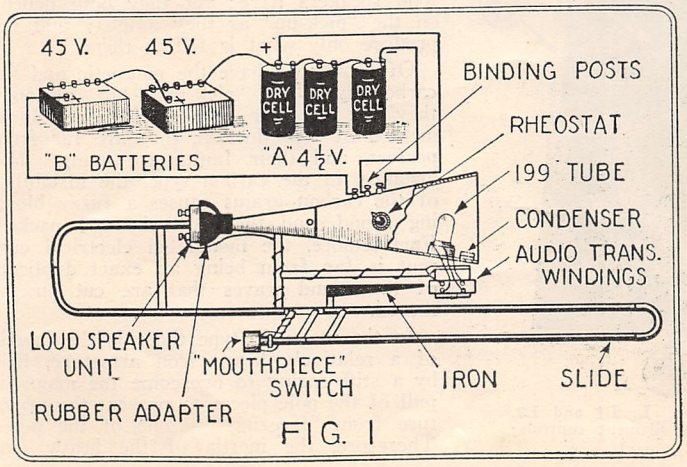


Fig. 4 shows how one of the brackets that came with the curtain rods was fastened to the loud-speaker unit. This slips into the rod and can then be soldered very easily. The unit is connected to the horn by one of the well-known rubber phonograph adapters. The extension of the card-board megaphone used for the horn was made from a small metal wind instrument bought in Woolworth's. The sound-producing mechanism has been removed. In the model shown I used a nail punch for the moveable iron piece but a pair of shears with tapering blades would be better; as, the more tapering the iron, the greater distance it can be moved to produce a note.

(*Continued on page* 1290)

Combining the Phonograph and Radio

New Pick-Up Device and Amplifier Improves Quality of Phonograph's Reproduction

By F. A. JEWELL*

The author, illustrating the use of the "pick-up" device, proves that it is as simple to operate as the average phonograph, with the single exception that a filament switch must be closed.

HERE is an entirely new device which applies radio principles to the phonograph. Electro-magnetic devices, microphonic devices, and others have been frequently used, but this is the first time that the condenser principle with large amplification has been used in phonograph reproduction work. The results obtained are most astonishing and bid fair to revolutionize phonograph standards. The quality obtained with the new device is greater than it was thought possible heretofore to produce.— EDITOR.

MUCH is being said and done relative to the merits of the phonograph and the radio. To quote one authority, who is defending the phonograph: "Static is awful, and the difficulty of tuning out—and now they are stealing each other's wavelengths, but they want good music and they have found it is not to be had in the radio." The other side of the argument is brought out by another authority, who is defending radio, and he says: "As for quality, it is the belief of any unprejudiced expert that in many cases the radio—provided that it is of good make and has a good loud speaker—will deliver quality exceeding that of the phonograph. Furthermore, the scratchy sound produced by every phonograph is highly objectionable."

We could go on indefinitely quoting both sides, bringing out the good points of both the radio and the phonograph, and accentuating the objectionable features that are to be found in them; but it is the unanimous opinion of the public that what is wanted is good reproduction, or in other words, acceptable entertainment, whether it be radio or phonograph, or a combination of both.

In the combination of both we have a clew. If we could incorporate in one unit the advantages of both, with all of their objectionable features eliminated, we would then achieve the results that both sides are trying to obtain.

RADIO IN PHONOGRAPH WORK

Radio has done much recently in advancing the phonographic art. Electrical recording was borrowed from the radio, and the microphone and vacuum-tube amplifier have supplanted the old method of singing, talking and playing directly into a horn, thus depending on the energy of a sound wave impinged upon a diaphragm to do the cutting. Obviously the acoustic problems of this method were many. At its best, it was far from perfect, as most of the harmonics and overtones were completely lost, and even some of the fundamental waves, especially the low or bass notes, failed to register.

The adoption of the microphone amplifier and electrically-operated cutting stylus has overcome most of these problems and the result is the production of better records. Of course, electrical recording will be greatly improved in the future, for it is still in its infancy. A comparison between it and the old air-column method is so greatly in favor of the former that the old method was doomed and is now a thing of the past.

This method has been applied to reproduction by reversing the principle; that is, an electrical "pick-up" instrument travels in the record groove and converts the sound waves into electrical impulses. These impulses are then amplified and reproduced by a loud speaker. This method also shows a decided improvement over the old air-column method, for its problems were as bad and as complicated as the recording. Here again the phonograph has borrowed from the radio. Now that the radio and the phonograph are permanently allied, the practical thing to do is to improve the means and methods of electrical recording and reproduction.

This article will deal only with reproduction, as that is by far the most interesting to the millions who now own radio sets and phonographs, which, in many cases, have become obsolete with the tremendous advancements that has been made in both industries in the last year.

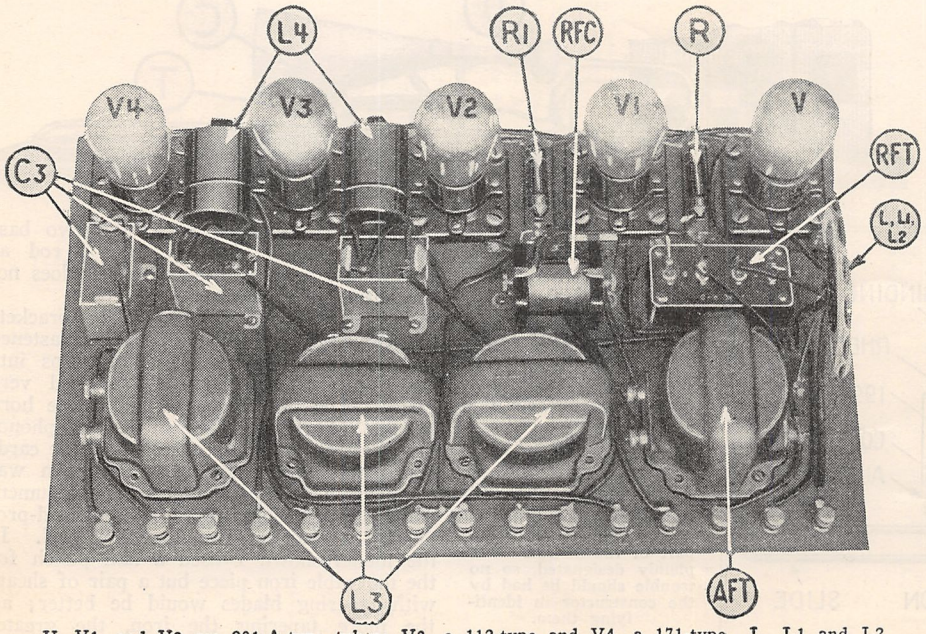
OLD MODEL "PICK-UPS"

It is readily apparent that in electrical reproduction, the quality of sound from the loud speaker can be no better than the speaker itself, the amplifier that feeds it; and both in turn depend on the record "pick-up."

Obviously, in this process of perfecting electrical reproduction, we should begin with the "pick-up," because it has not been perfected to the point that amplifiers and loud speakers have; yet they both depend on the "pick-up" as they amplify and reproduce only what is fed to them.

Of course we have the magnetic and the carbon types of "pick-up," but, although they are superior to the old air column method of reproduction, they are far from perfect, and their faults are many. For instance, in the carbon type, the instability of the carbon grains causes a fuzzy blowing sound, and they soon become packed. Furthermore, the modulated electrical current is far from being an exact duplicate of the sound waves that are cut on the record.

In the magnetic type there is the inertia of a relatively heavy iron armature, held by a stiff spring to overcome the magnetic pull of the pole pieces to prevent the armature from "freezing" to one of the poles. Therefore, the inertia of the heavy iron



V, V1, and V2 are 201-A-type tubes; V3, a 112-type and V4, a 171-type. L, L1 and L2, spider-web coils; L3, A.F. chokes; L4, grid impedances; R-R1, automatic filament controls; C3, 1.0-mf. condensers.

Consulting Engineer, S. and U. Holding Corp. (Adams-Sibley Developing Corp.)

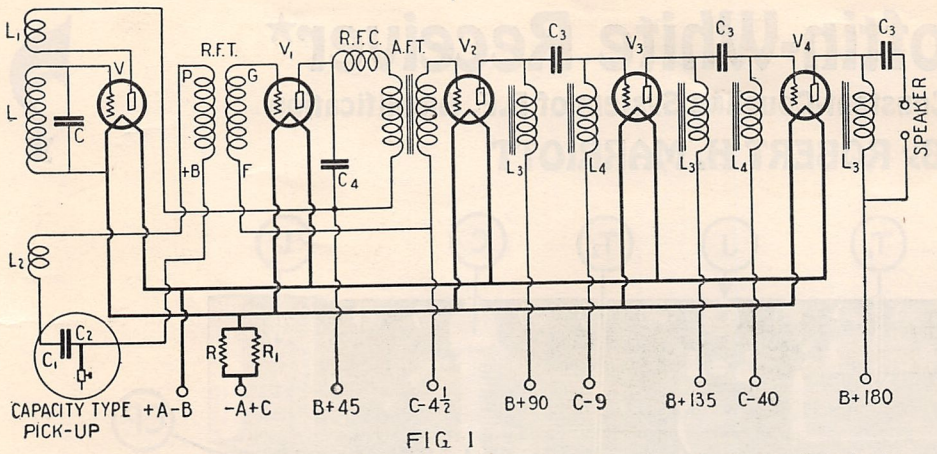


FIG. 1

This schematic diagram of the oscillator and audio amplifier shows how the "pick-up" device is electrically incorporated in the circuit.

armature and the tension of the spring make it very difficult for the instrument to respond to the delicate harmonics and overtones. Also, the natural frequency of vibration of the armature, which is in the audio band, causes a "blasting" on certain notes.

Then again, the energy generated by the movement of the armature to and from the pole pieces is in proportion to the *square* of the distance of travel; which means that the current output is distorted, relatively to the sound waves cut on the record. The realization of these faults, the limitations of each type of a "pick-up," and the desirability of overcoming them have prompted the development of this new system of converting sound waves into electrical pulsations by mechanical means, and are responsible for the remarkable results obtained.

"BROADCASTING" A RECORD

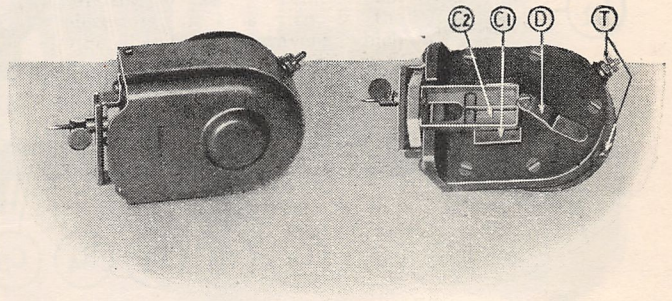
Apparently most of the objections to both the phonograph and the radio have been eliminated with this new system, while most of their advantages have been retained. This has been accomplished by utilizing the *principles of radio* for phonograph reproduction throughout. What is meant by that is this: a high-frequency carrier wave is modulated by the sound wave cut on the record and is rectified, amplified and reproduced just as it is in radio, which gives you the same effect as a broadcast station sending direct to your receiver. In other words, you have your own broadcast station sending direct to you the program you most desire in the form of the records you select, without interference, static, fading, etc. With the new electrical-process records, the modulation is equal to, and, in most cases, better than that of the best broadcasting stations, without the scratching of the needle on the record, with a perfect quality of tone and with all the volume that could be desired.

Right here a reasonable question may be asked: how is the scratching of the needle on the record overcome? The answer is this: it is a well known fact that from 80 to 90 per cent of the scratching is caused by the needle's scraping along the bottom of the groove of the record, causing a vertical movement, while sound waves are cut laterally on the side of the record. Advantage is taken of this fact in this way: any vertical movement will not cause an electrical change and the remaining 10 to 20 per cent, caused by the lateral movement, or what is known as "side-wall scratch," is damped out to a negligible point.

ACTION OF THE MODULATOR

Fig. 1 is a schematic diagram that briefly explains this system. The first tube, V, is oscillating at a frequency governed by the inductances of L and L1 and the capacity C. This may be any of the conventional oscillating circuits. Conductively coupled to the oscillating coil is a "pick-up" coil, L2, which is in series with the capacity-type "pick-up," C1-C2, and a radio-frequency transformer, RFT, that is broadly tuned to the frequency of the oscillations. The amount of radio-frequency current flowing in the primary of the R.F. transformer is governed by the capacity of C1-C2. Plate C1 is fixed, while C2 vibrates, causing a variable radio-frequency current to flow in this circuit in exact proportion to these vibrations. C2 is fastened to a stylus that is traveling in the groove on a record and is vibrated by the sound waves cut in the record groove. Therefore, the modulated-frequency current, flowing in the primary of the R.F. transformer, is transferred to the secondary and rectified by any of the conventional detector circuits, and is then passed through the usual filter circuit and on to the audio amplifier and loud speaker.

Now, inasmuch as the frequency passing through C1-C2 is very high (in the millions) these plates are very small. Consequently, the vibrating member is very light, being made of aluminum. Furthermore, as this vibrating member does not have to perform any appreciable mechanical work (such as moving an air column or working against a heavy spring tension, as in a magnetic type of a "pick-up") it is allowed to float in the record groove. As it has very little inertia, it can readily respond to all the delicate overtones, as well as all the fundamental notes. Also, as there is only one frequency to contend with, that of the oscillator, and since the only function of the capacity type of "pick-up" is to vary the amplitude of this frequency, no difficulty is encountered in designing a circuit to respond to it.



At the right are shown two views of the "pick-up" device which converts mechanical energy into electrical. C1 is the stationary and C2, the moveable plate, of the condenser, D is the damping device and T, the terminals.

When the modulated radio-frequency current is rectified in the detector circuit and filtered, an electrical wave, which exactly corresponds to the sound waves cut on the record, is transmitted to the audio amplifier for additional amplification. If

(*Continued on page* 1274)

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER ★	
L3	3	A. F. Chokes	200 H.		1	
AFT	1	A. F. Transformer	4 : 1		1	2,14,15
RFC	1	R. F. Choke	85 MH		2	9
RFT	1	R. F. Transformer		Type R2	1	
C	1	Condenser	.00025 mf.	Oscillator tuning	4	5,13
C1,C2	1	"Pick up"			8	
C3	3	Fixed Condenser	1 mf.		4	5,13
C4	1	Condenser	.001 mf.	By-pass	4	5,13
R1	1	Auto. Fil. Cont.	5 v. ¾ amp		6	
R	1	Auto. Fil. Cont.	5 v. 1 amp		6	
	5	Sockets		UX type	7	14,15
L4	2	Grid Impedances	2,000 H.		8	
L,L1,L2	¼lb.	Wire for coils	# 26 D.C.C.		10	
V,V1,V2	3	Tubes	5 v. ¼ amp		11	12
V3	1	Tube	5 v. ½ amp	Semi-power	11	12
V4	1	Tube	5 v. ½ amp	Power	11	12

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Acme Apparatus Co.
2 Samson Electric Co.
3 Thordarson Elec. Mfg. Co.
4 Dubilier Cond. & Radio Co.
5 Tobe Deutschman
6 Radiall Co.
7 Benjamin Elec. Mfg. Co.
8 S & U Holding Corp.
9 Hammarlund Mfg. Co.
10 Belden Mfg. Co.
11 Radio Corp. of America
12 C. E. Mfg. Co. (Ceco)
13 Electrad, Inc.
14 Silver-Marshall, Inc.
15 General Radio Co.

If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible difference in size from those originally used in laying out and drilling the panel and sub-base.

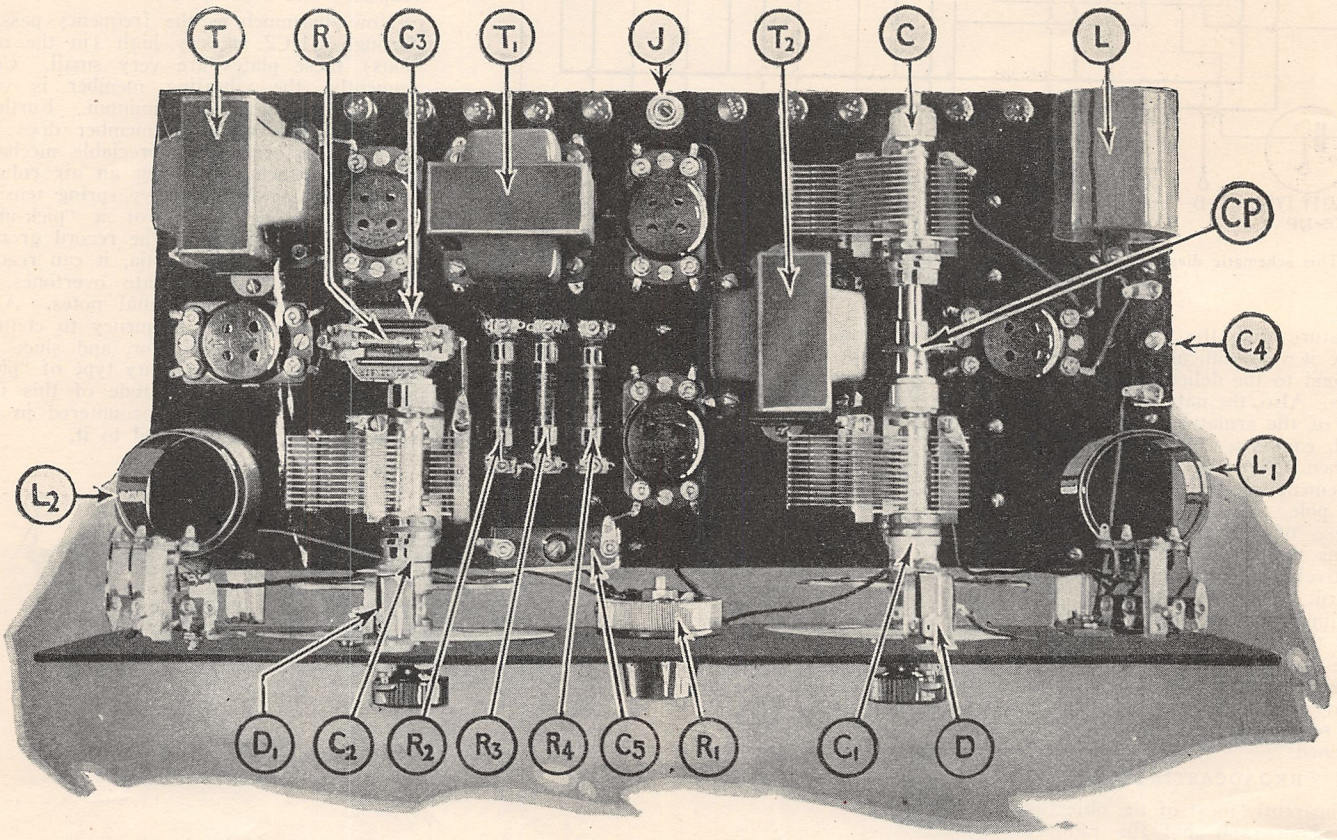
FORM COPYRIGHT EXPERIMENTER PUB. CO. 1927

★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

The Loftin-White Receiver*

Employing the Constant-Coupling System of R.F. Amplification

By ROBERT H. MARRIOTT



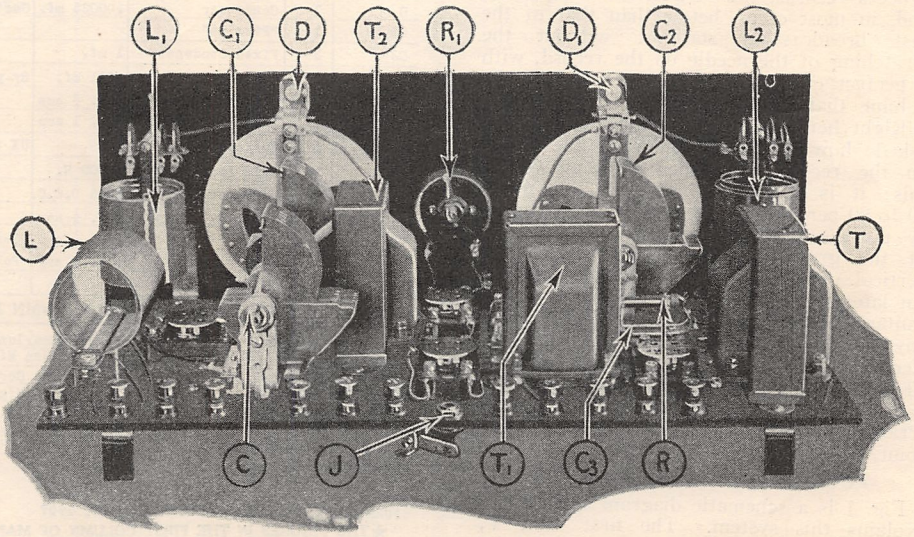
A top view of the completed Loftin-White receiver. The parts are: D and D1, the illuminated vernier dials; C, C1 and C2 the tuning condensers. C3, grid condenser; C4 and C5, phase-shifting condensers; L, antenna coupler; L1 and L2, R.F. transformers with adjustable primaries; R, grid leak; R1, rheostat; R2, R3 and R4, automatic filament controls; T and T1, A.F. transformers; T2, output transformer; J, jack for external power amplifier and CP the coupling unit connecting condenser C and C1

IN the March issue of RADIO NEWS Mr. Marriott gave us full details of the new constant-coupling system of radio-frequency amplification developed by Messrs. Loftin and White, both prominent radio engineers. The system is such a radical departure from the usual form that it has received wide notice. Fom the point of theory, the circuit arrangement is ideal, as it provides equal amplification at all broadcast frequencies. In this article Mr. Marriott goes into details on the construction, adjustment and operation of this excellent receiver. —EDITOR.

IN my article last month I covered the details of the Loftin-White constant-coupling circuit from the technical aspect only. This was more in the form of an introduction intended for the man having a fair knowledge of radio. No doubt many readers failed to understand just how this new circuit functions. This time I will try to satisfy the radio fan who has little idea of radio terms and who finds the usual descriptions of operation perplexing. And after that we will get right down to the building of the set itself.

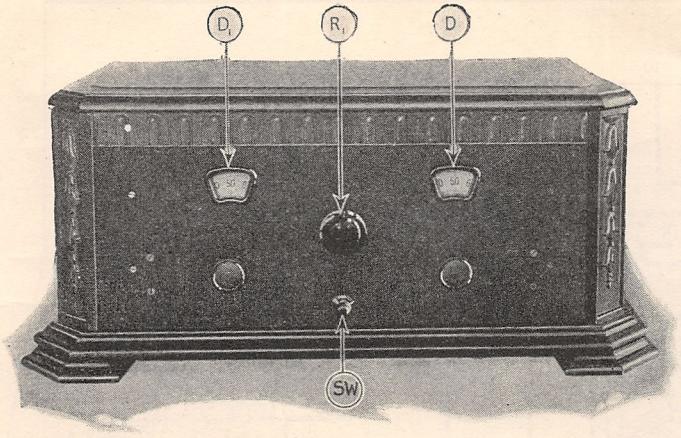
You have probably noticed, through experience with your own radio set, that you do not get as good results on the longer wavelengths as you do on the shorter ones; that is, the short-wave stations, even those some distance away, have more of a "kick" to them. The reason for this is that your set does not amplify the long waves as well as the short ones. Now, if you were to try to make the set more sensitive on these long waves, it would be too sensitive on the short ones and we would run into the difficulty known as oscillation.

The limit of sensitivity is just below this point of oscillation; any point above it is unsuitable for the reception of broadcast programs. It is obvious that the ideal plan would be to have a receiver with some sort of an automatic control, requiring no manual adjustment, which would maintain the receiver at the maximum point of sensitivity irrespective of the wavelength to which it was tuned. It sounds very simple but, really, it isn't any such thing. Engineers have been doing their best to develop just such a circuit, but until the arrival of the Loftin-White arrangement the best any of us could do was to snub oscillation tendencies at the low wavelengths with some sort of neutral-



A rear view of the completed receiver. The symbols are the same as in the illustration above, The R.F. transformers L1 and L2 are not attached to the variable condensers, but have screws so that the degree of coupling can be adjusted. The rheostat R1 controls the filament current to the two R. F. amplifier tubes.

*RADIO NEWS *Blueprint Article No.* 16.



A panel view of the completed Loftin-White receiver in its cabinet. SW is the filament switch, R1, the R.F. tube rheostat, and D and D1 are the illuminated vernier dials, the knobs of which are directly below the scales.

izing device and be philosophical concerning the sacrifice made at the longer wavelengths—just to keep the set from being a nuisance.

The trouble we had with most of our neutralizing devices came out of the fact that none of them which was anywhere near efficient was independent of wavelength or frequency. You could adjust them for some particular band of frequencies, at which points they did the trick, but, as soon as the set was tuned to the very high or the very low broadcast frequencies, the electrical value of the device would automatically change and consequently its main purpose would be defeated. We have used coils and condensers and many combinations of the two in our circuits in an attempt to stabilize them, but since both of them vary through wide extents with a change of frequency, we have always ended up exactly where we started.

INDUCTANCE vs. CAPACITY

Messrs. Loftin and White use coils and condensers for the very purpose we have been discussing, but they started out in a new way in the beginning and did not encounter downfalls. The idea they have is so simple, after it has been told you, that it seems surprising that someone didn't think of it before. We have mentioned that both coils and condensers vary in value with a change of frequency, but the odd thing about them is that they vary in opposite directions; *i.e.*, the resistance of a coil *decreases* as we increase the wavelength, but the resistance of a condenser *increases*, and vice versa. If we show this increase or decrease in resistance (impedance and reactance) with a change in wavelength or frequency, as curves on graph paper, we see that in one case the curve rises and in the other case it descends.

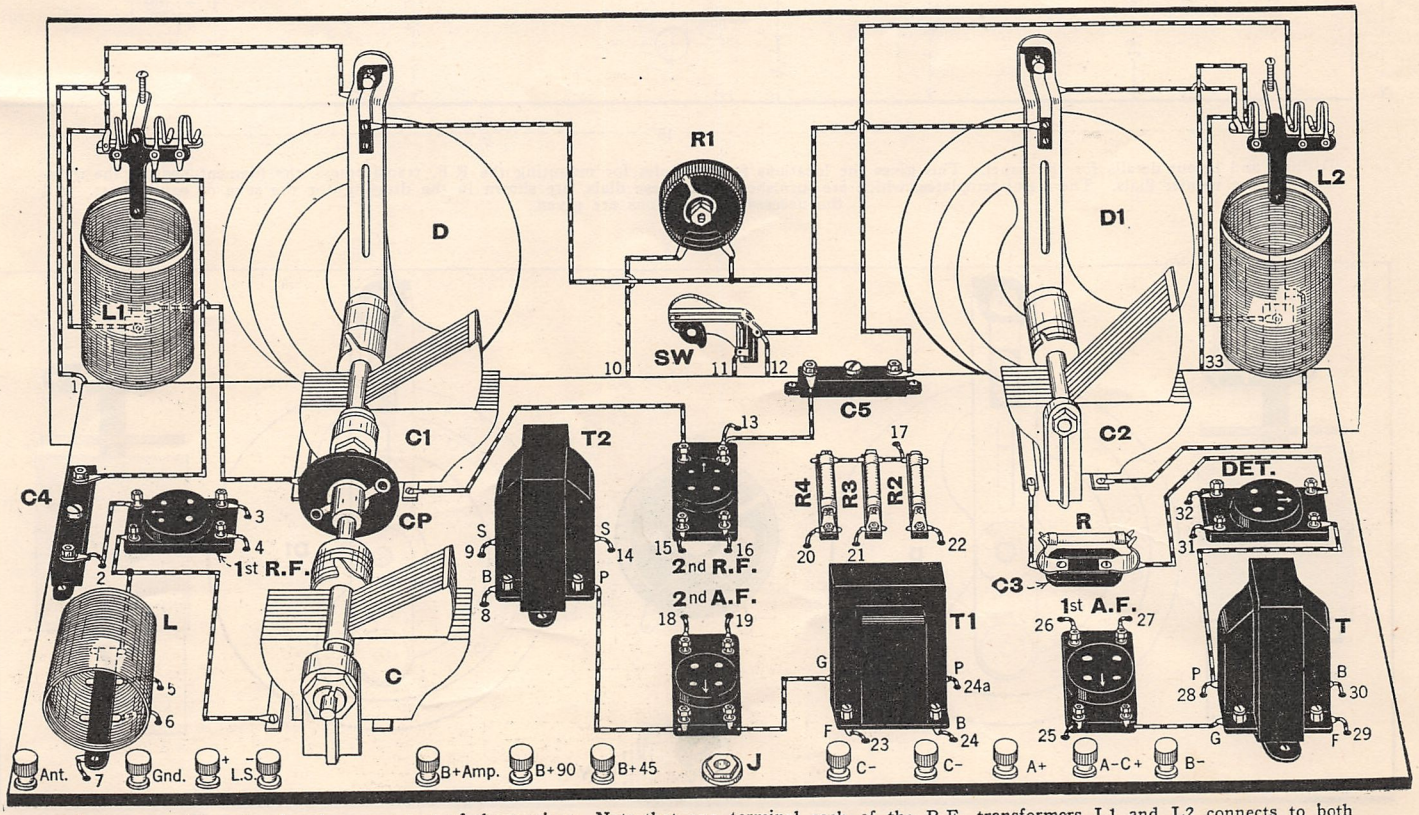
If we take the two curves, one for a condenser and one for a coil and place them one over the other so that both can be observed, we note immediately that one compensates for the other; so that, if we combine a coil and a condenser in a radio circuit and get their proportionate values correct, the resistance in the circuit will be practically constant irrespective of the wavelength or frequency, for as one decreases in resistance the other is increasing by a like amount. That is the backbone of the Loftin-White principle. They call it the "constant-coupling" system because the combination of the coils and the condensers is such that the transfer of energy from one circuit to the other is the same for all wavelengths; in other words the coupling between the circuits is made constant.

DESIGNING THE RECEIVER

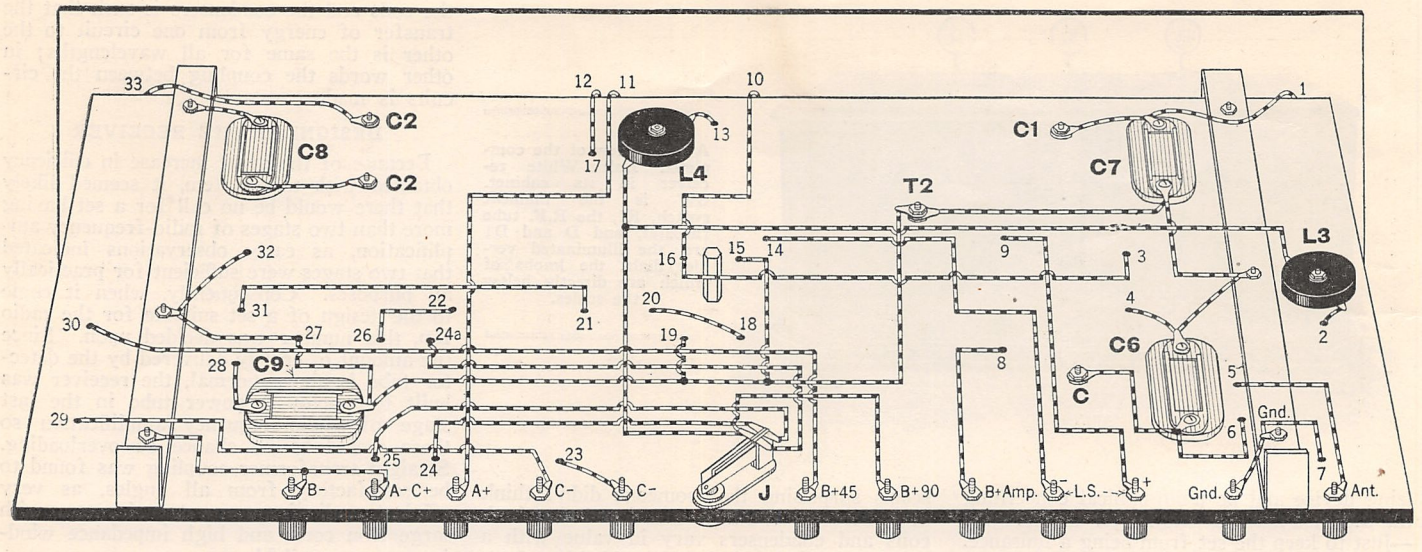
Because of the great increase in efficiency obtained with this system, it seemed likely that there would be no call for a set having more than two stages of radio-frequency amplification, as early observations indicated that two stages were sufficient for practically all purposes. Consequently, when it came to the design of a set suitable for the radio fan, this number was decided upon. Since the amount of energy delivered by the detector tube is above normal, the receiver was built to employ a power tube in the last stage of audio-frequency amplification so there would be no chance of overloading. Straight transformer coupling was found to be satisfactory from all angles, as very efficient audio-frequency transformers with large iron cores and high impedance windings were available.

The complete receiver is shown in the accompanying illustrations. The condensers which tune the aerial or first R.F. circuit and the second radio-frequency stage are mounted together that they may be operated by a single dial. The other dial controls the detector input. The rheostat, R1, which controls the flow of filament current to the two R.F. tubes is employed as a volume regulator. All other tubes employ automatic filament controls. Since a power tube of the 171 type is employed it is necessary to use an output device to protect the loud speaker from harm. An output transformer, T2, the characteristics of which match those of the two A.F. transformers, T and T1, is used for this purpose.

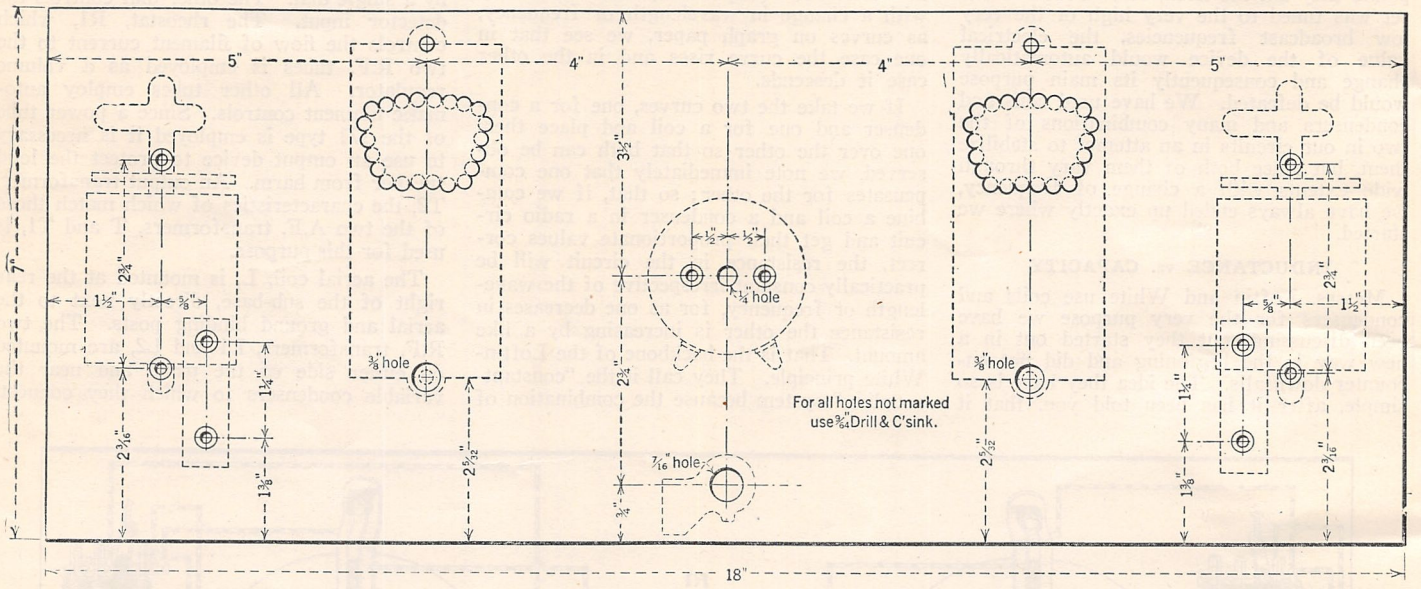
The aerial coil, L, is mounted at the rear right of the sub-base, directly next to the aerial and ground binding posts. The two R.F. transformers, L1 and L2, are mounted on either side of the panel and near the variable condensers to which they connect.



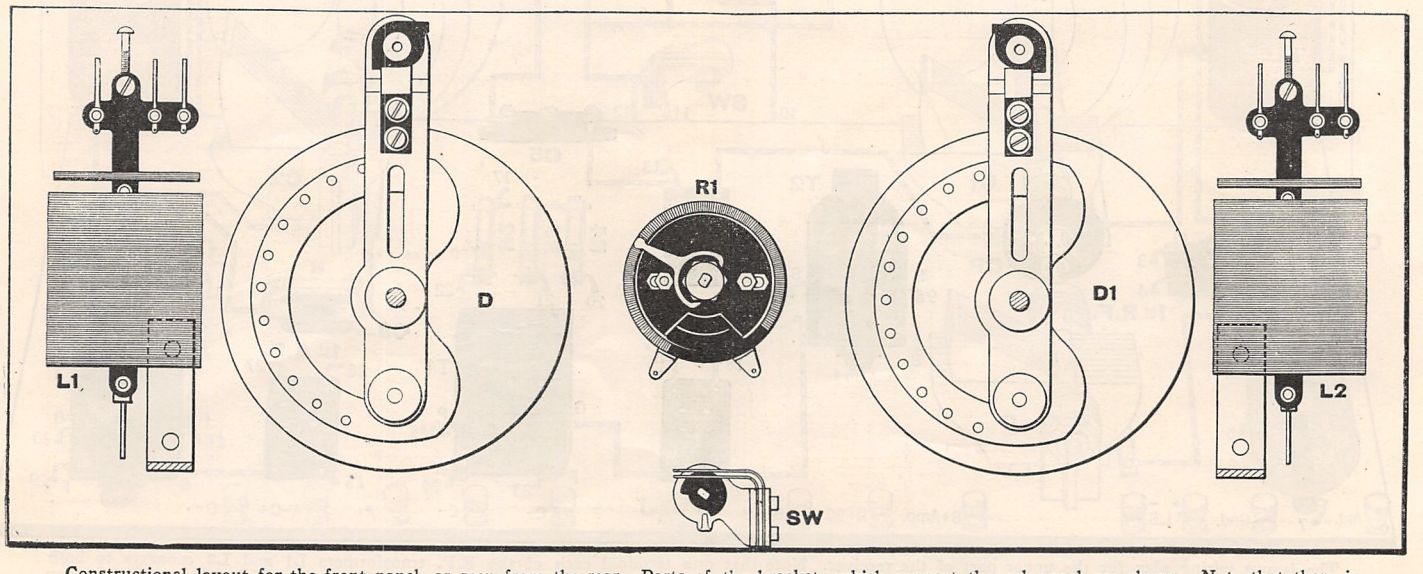
The layout wiring plan for the upper part of the receiver. Note that one terminal each of the R.F. transformers L1 and L2 connects to both the dial lights and the sub-panel brackets. Also, the grid return of the detector tube goes to the negative "A" lead; which is most satisfactory when using a tube of the 200-A type. Each wire is numbered where it passes through the sub-panel and carries the same number on the view of the under side.



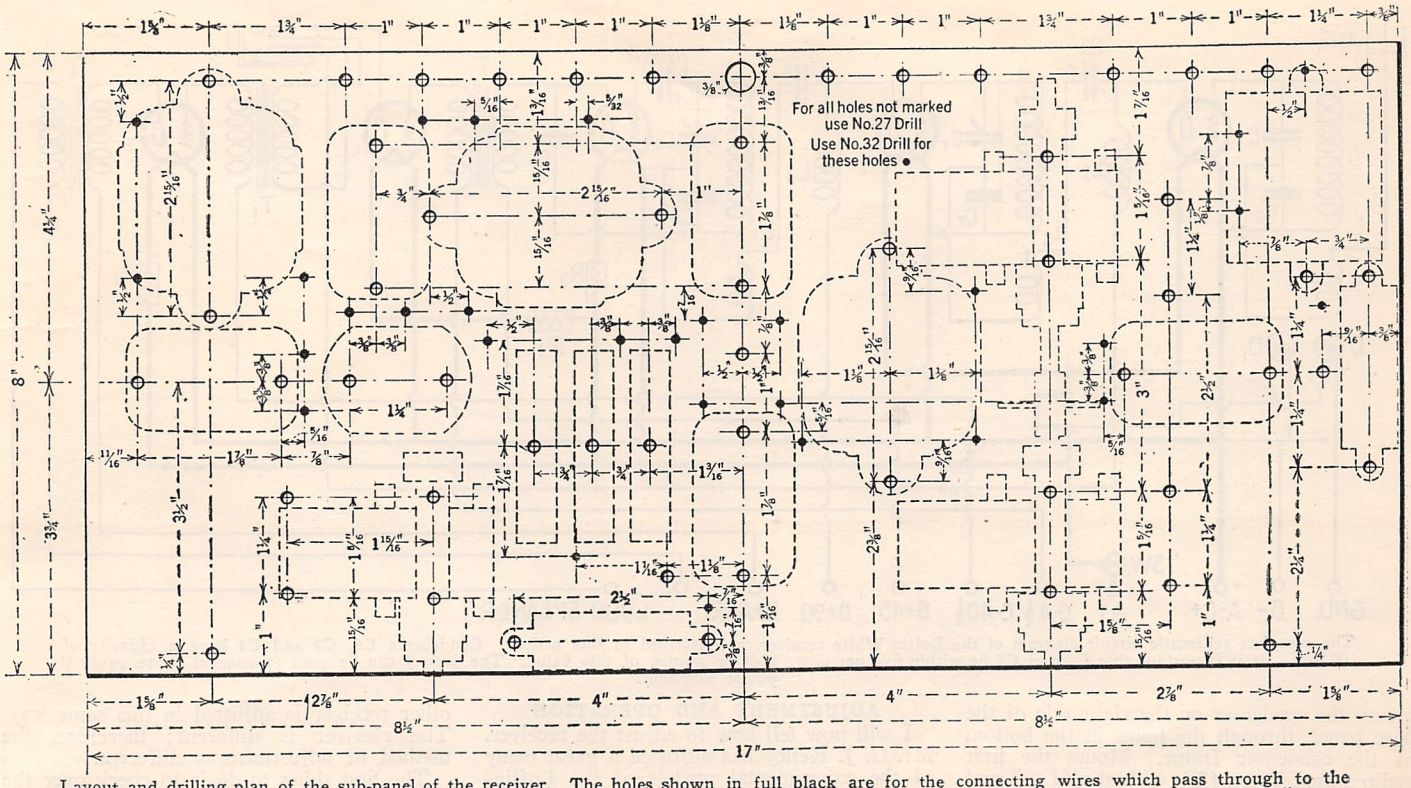
A pictorial wiring plan of the under side of the sub-panel. Note that a great many connections are made to the two support brackets. The brackets form a common "A" battery connection. L3 and L4 are the two R.F. chokes; C6, C7 and C8 are the .004-mf. fixed condensers, while C9 is the .001-mf. by-pass condenser connected across the primary of the A.F. transformer T. The terminal posts marked C, C1, C2 and C2 are the connections from the rotor plates of the variable condensers. Terminal post T2 is one of the mounting screws on the output transformer T2. Note the supporting pillar directly in the center of the sub-panel.



Drilling and layout details for the panel. This gives the locations for the holes for mounting the R.F. transformers, the filament switch, the rheostat and the vernier dials. The metal templates, which are furnished with these dials, are shown in the drawing for the sake of explicitness. All the necessary dimensions are given.



Constructional layout for the front panel, as seen from the rear. Parts of the brackets which support the sub-panel are shown. Note that there is a cam-type switch at the top of each dial. These are for turning the dial lights on and off.



Layout and drilling plan of the sub-panel of the receiver. The holes shown in full black are for the connecting wires which pass through to the under side. Dotted lines indicate the positions of the apparatus on top of the sub-panel. All the necessary dimensions for layout and drilling are given.

The R.F. choke coils and the fixed condensers are mounted on the underside of the sub-base.

Now let us get down to the actual construction of the receiver.

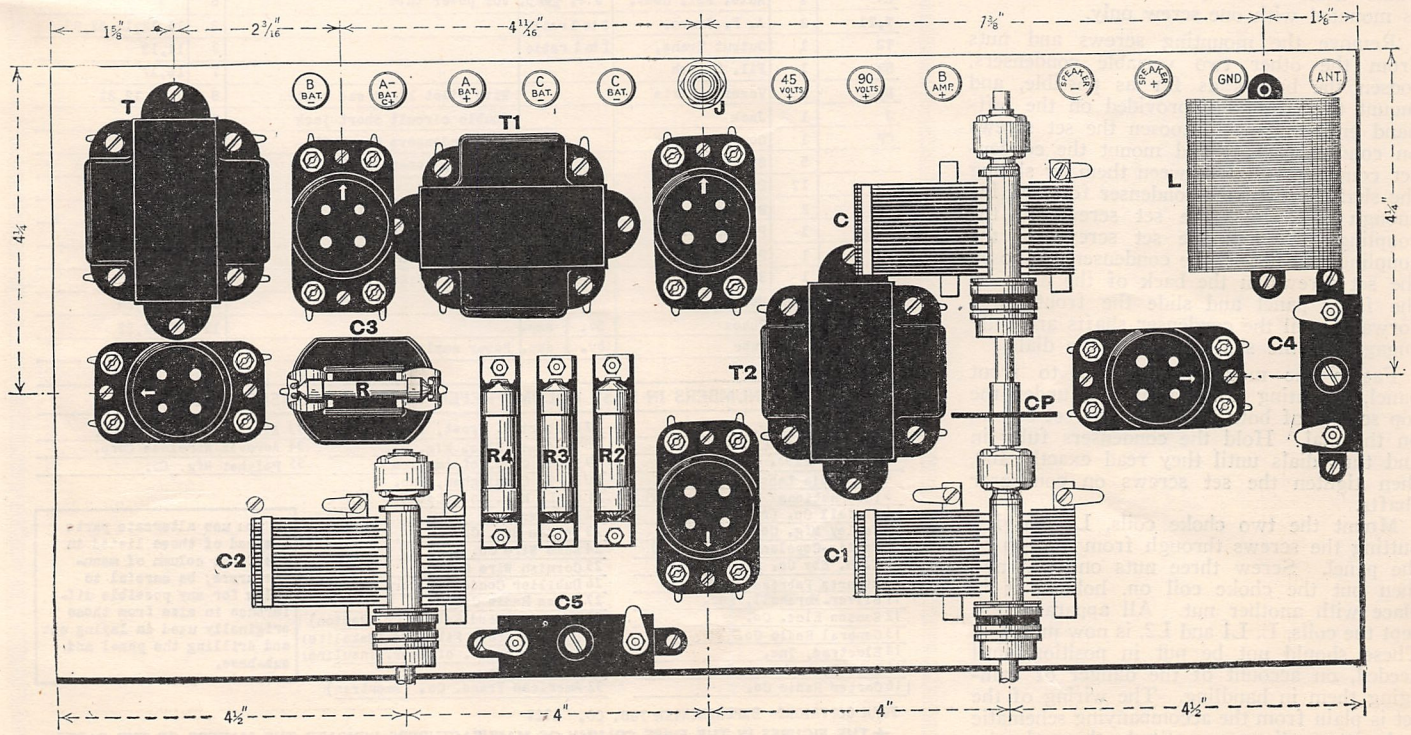
ASSEMBLY AND WIRING

Mount the rheostat, R1, with two screws, and with the binding posts toward the bottom of panel. When mounted, the contact arm should turn without touching the mounting screws. Mount the switch, SW, with the springs up, parallel to the lower edge of the front panel. Next mount the two illuminated dials, D and D1. Remove the mounting brackets, as they are not used in this set. Mount bezel and dial as per instructions, but do not tighten the mounting nuts. Lay the sub-panel so that the large hole is toward you, the side with six small holes is to your right and eight small holes to the left.

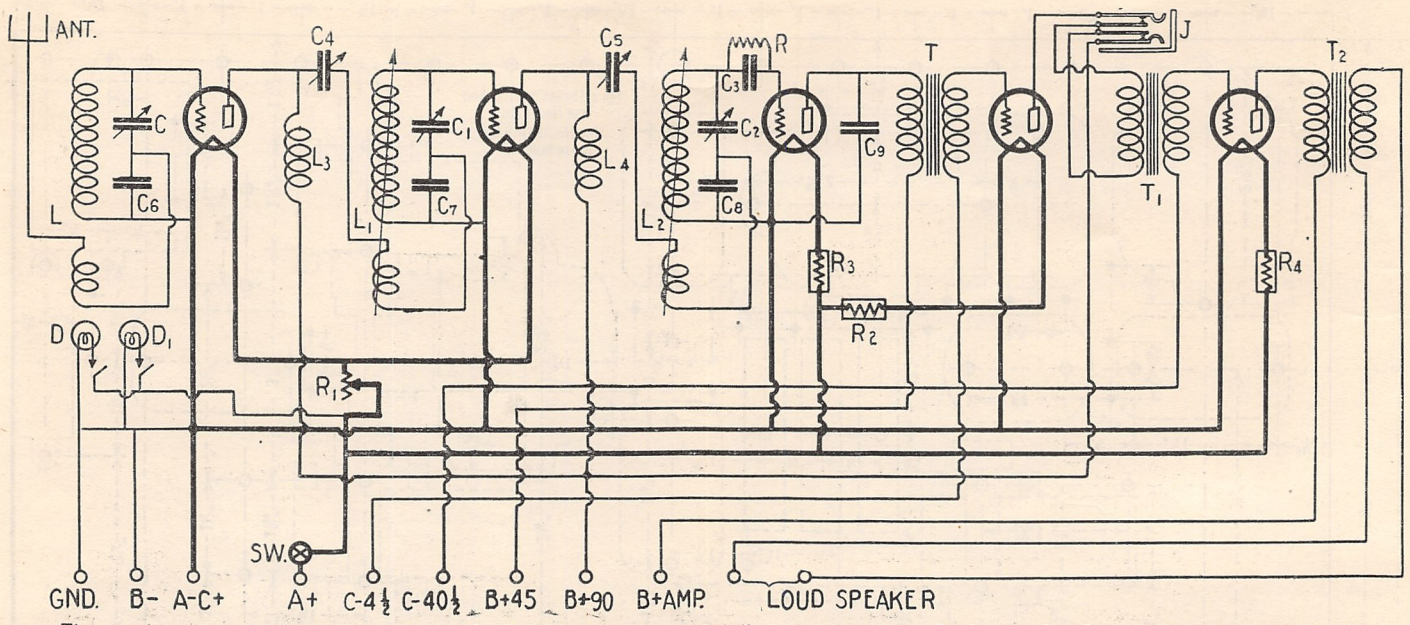
Mount the first R.F. socket at the extreme left of the panel. The screws and nut on the grid end of the socket are used to hold to the panel, the mounting bracket, which should be mounted at the same time as the socket. Place a soldering lug under the nut on the bottom of the panel. Mount the "ground" binding post through the small hole at the back of panel and the hole in the mounting bracket; place a soldering lug under the nut on the bottom of the panel. Mount the other four sockets in position as shown in the illustrations. Mount the two phasing condensers, C4 and C5, and place a soldering lug under each binding post on them.

Mount the three automatic-filament-control bases with flat-head screws. Bend the soldering lugs on the jack, J, down, being careful that they do not touch each other; then mount the jack in the large hole at the back of the sub-panel. Mount the twelve binding posts in the holes at the back of panel, with a soldering lug under each, putting two lugs under the "B—" post.

Remove the mounting screws and mounting nut from one of the variable condensers. These may be thrown away as they are not used. Loosen the brake-band screw as far as it will go without coming off. Then



Constructional layout drawing of the sub-panel. It is advised that this arrangement of the apparatus be strictly followed. It has both mechanical and electrical advantages.



The complete schematic circuit diagram of the Loftin-White receiver, as described in this article. Condensers C6, C7 and C8 have a capacity of .004-mf. It is important that C6 and C7 be within five per cent., plus or minus, of this value. The jack J can be used to connect in an external power amplifier.

mount the condenser on the right side of the base panel, through the holes in the bottom of the condenser frame. Mount the first audio transformer (T) with the "F—" and "G" posts to the rear; the two screws which hold this transformer in place pass through and hold the right-hand mounting bracket. Mount soldering lugs under both nuts. Complete the mounting of the brackets by putting the screws in place at the front of the base panel, with a soldering lug under the one on the right-hand bracket.

Then mount the middle or second audio transformer (T1). If the fourth socket is in the way it may be taken out in order to get the mounting screws in. Mount the transformer so that the "B+" and "F—" posts are to the back of the panel. Mount the output transformer (T2) with posts "B+" and "P" to rear, placing two soldering lugs under the front mounting nut. Mount the pillar post in the center of the base panel. Mount the .001-mf. condenser (C9) on the screw holding the "B+P" side of the second audio transformer (T1). This condenser is mounted with one screw only.

Remove the mounting screws and nuts from the other two variable condensers, loosen the brakes as far as possible, and mount them in holes provided on the left-hand end of panel. Loosen the set screws on condenser shaft and mount the condenser coupling (CP) between them by sliding the shaft of the back condenser forward far enough to engage the set screws in the coupling. Tighten the set screws in the coupling, but not on the condensers. Loosen the set screws in the back of the dials on the front panel and slide the front panel forward until the condenser shafts are fully engaged in the shaft holes of the dials.

Fasten the mounting brackets to front panel, mounting a soldering lug under the top screws of both. Tighten the set screws on the dial. Hold the condensers fully in and turn dials until they read exactly 100, then tighten the set screws on condenser shafts.

Mount the two choke coils, L3 and L4, putting the screws through from the top of the panel. Screw three nuts on tight and then put the choke coil on, holding it in place with another nut. All apparatus except the coils, L, L1 and L2, is now mounted. These should not be put in position until needed, on account of the danger of damaging them in handling. The wiring of the set is plain from the accompanying schematic and picture diagrams. Study them closely, and you will have no trouble in connecting the instruments correctly.

ADJUSTMENT AND OPERATION

I will now tell how to adjust the receiver. Mr. G. J. Kelley has adjusted a great many of the experimental models of the Loftin-White circuit and therefore I am using his experience largely in trying to describe the simplest way to adjust this receiver. No other receiver is adjusted in this same way. The receiver is different; therefore, the method of adjustment is different.

The first thing to do is to check over the set, step by step, using the schematic and picture diagrams as guides.

(*Continued on page* 1280)

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER ★	
L	1	Ant. Coupler			1	
L1,L2	2	R. F. Trans.		With adjustable coupling	1	
L3,L4	2	R. F. Chokes		Special	2	
C,C1	2	Var. Condensers	.0005 mf.	Straight line tuning type	1	11,12,13,18,31
C2	1	Var. Condenser	.0005 mf.	Straight line tuning type	1	11,12,13,18,31
C3	1	Grid Condenser	.00025 mf.	With mounting clips for leak	3	14,34,35
C4,C5	2	Adj. Condensers	.0005mf.max	Phase shifting condenser	4	
C6,C7,C8	3	Fixed Condensers	.004 mf.	Accuracy of value important	3	
C9	1	Fixed Condenser	.001 mf.	By-pass	3	14,15,34,35
R	1	Resistor	2 megs.	Grid leak	5	14,15,26,27
R1	1	Rheostat	10 ohms	For R. F. tubes	2	7,8,13,16,17
R2,R3	2	Auto. Fil. Cont.	5 v. ¼amp.		6	
R4	1	Auto. Fil. Cont.	5 v. ½amp.	For power tube	6	
T,T1	2	A. F. Trans.	3 to 1 ratio		2	11,12,13,32,33
T2	1	Output Trans.	1 to 1 ratio		2	11,13
SW	1	Fil. Switch			7	16,17
D,D1	2	Vernier Dials		With pilot light and switch	8	9,11,12,31
J	1	Jack		Double circuit short jack	7	16,17
CP	1	Coupling Unit		For condensers C and C1	2	
	5	Sockets		UX type, non-microphonic	2	9,11,13,17,18
	12	Binding posts			9	4,13
	2	Brackets		For mounting panel	2	
	1	Pillar Post		For supporting sub-base	2	
	1	Panel		7 X 18 X 3/16"	10	28,29,30
	1	Sub-base		8 X 17 X 3/16"	10	28,29,30
	25ft.	Hook-up Wire		Flexible	2	23,24,25
	4	Tubes	5v. ¼ amp.		19	20,21,22
	1	Tube	5v. ½ amp.	Power amplifier	19	20,21,22

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Hammarlund Mfg. Co.
2 Pacent Elec. Co.
3 Sangamo Elec. Co.
4 K-L Radio Labs.
5 International Res. Co. (Durham)
6 Radiall Co. (Amperite)
7 Yaxley Mfg. Co.
8 Martin-Copeland Co. (Marco)
9 H. H. Eby Co.
10 Micarta Fabricators
11 Silver-Marshall, Inc.
12 Samson Elec. Co.
13 General Radio Co.
14 Electrad, Inc.
15 Tobe Deutschmann Co.
16 Carter Radio Co.
17 Herbert H. Frost, Inc.
18 Benjamin Elec. Mfg. Co.
19 Radio Corp. of America
20 E. T. Cunningham, Inc.
21 C. E. Mfg. Co. (Ceco)
22 Magnavox Co.
23 Belden Mfg. Co.
24 Acme Wire Co.
25 Cornish Wire Co.
26 Dubilier Condenser Corp.
27 Daven Radio Corp.
28 American Hard Rubber Co. (Radion)
29 Diamond State Fibre Co. (Bakelite)
30 Insulating Co. of Amer. (Insuline)
31 National Co.
32 American Trans. Co. (Amertran)
33 All-American Radio Co.
34 Aerovox Wireless Corp.
35 Polymet Mfg. Co.

If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible difference in size from those originally used in laying out and drilling the panel and sub-base.

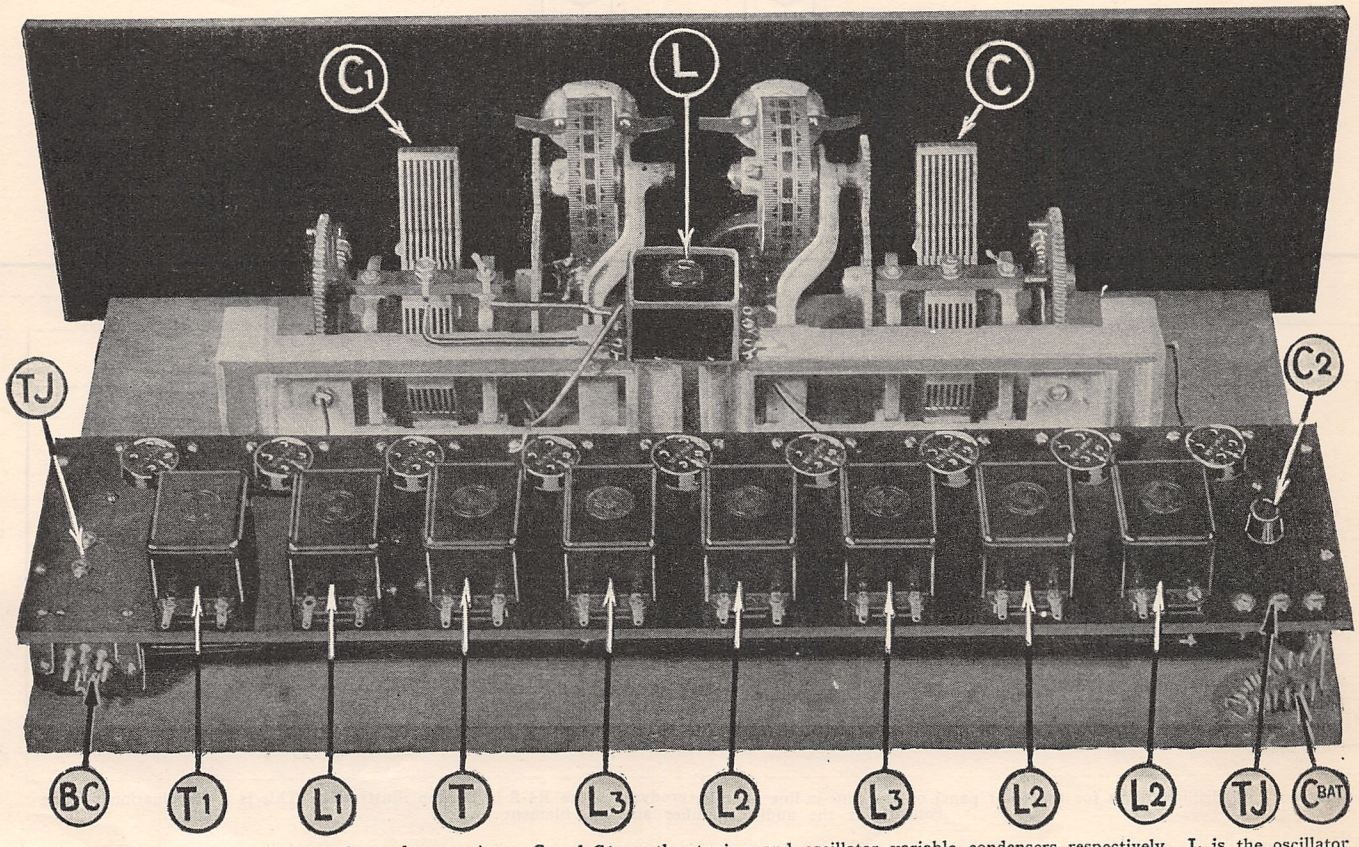
FORM COPYRIGHT EXPERIMENTER PUB. CO. 1927

★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

The "Nine-in-Line" Superheterodyne*

In Which are Combined Selectivity and Quality of Reproduction

By MARK R. HINDER



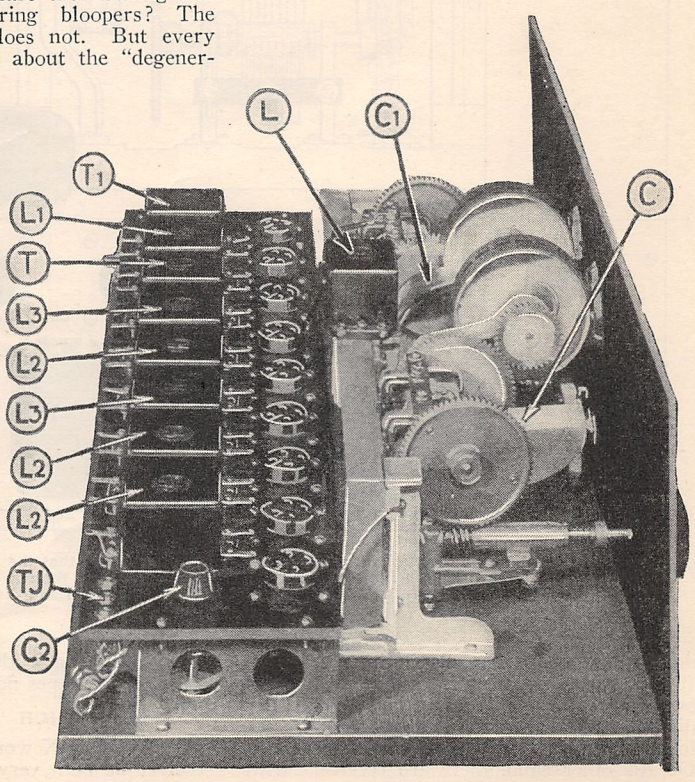
A rear view of the nine-in-line superheterodyne receiver. C and C1 are the tuning and oscillator variable condensers respectively. L is the oscillator coupler, mounted on the condenser frames; L1 the R.F. choke; L2 the iron-core I.F. transformers; L3 the air-core I.F. transformers; T and T1 the A.F. transformers; C2 balancing condenser; TJ, tip jacks; BC, battery-cable receptacle. The variable condensers are equipped with worm-gear vernier drives.

FOR several years the superheterodyne circuit has held charms for the experimenter of advanced experience. There are doubtless many fans newer to the game who would like to do some work with this interesting circuit, but the number of transformers, tubes, etc., often deters them, for two reasons. In the first place, there is the cost and, in the second, there is the complicated construction and wiring of the receiver. However, in the receiver described in this article the arrangement of the parts is relatively simple and their cost is far from prohibitive; so that it will more readily be possible for experimenters and set constructors to do good work along this line.—Editor.

A GREAT deal has been written about the so-called simple life that can be enjoyed in the country districts, and, generally, the "sophisticate" who lives in large cities reads such writings, and reading, sneers. Yet, from the point of view of the radio enthusiast, the country life has wonderful advantages.

Does the country dweller have any trouble with 1,000-watt stations in his back yard interfering with his distance reception? No, sir, he does not. Does he have to limit his list of stations to those in his immediate neighborhood? No indeed. If he has an average set plus a good antenna and ground, does he have trouble in tuning in stations whose distance can be reckoned in thousands of miles? You know the answer as well as we do.

Does he have to endure the howling and squealing of neighboring bloopers? The chances are that he does not. But every city dweller knows all about the "degenerative receivers."

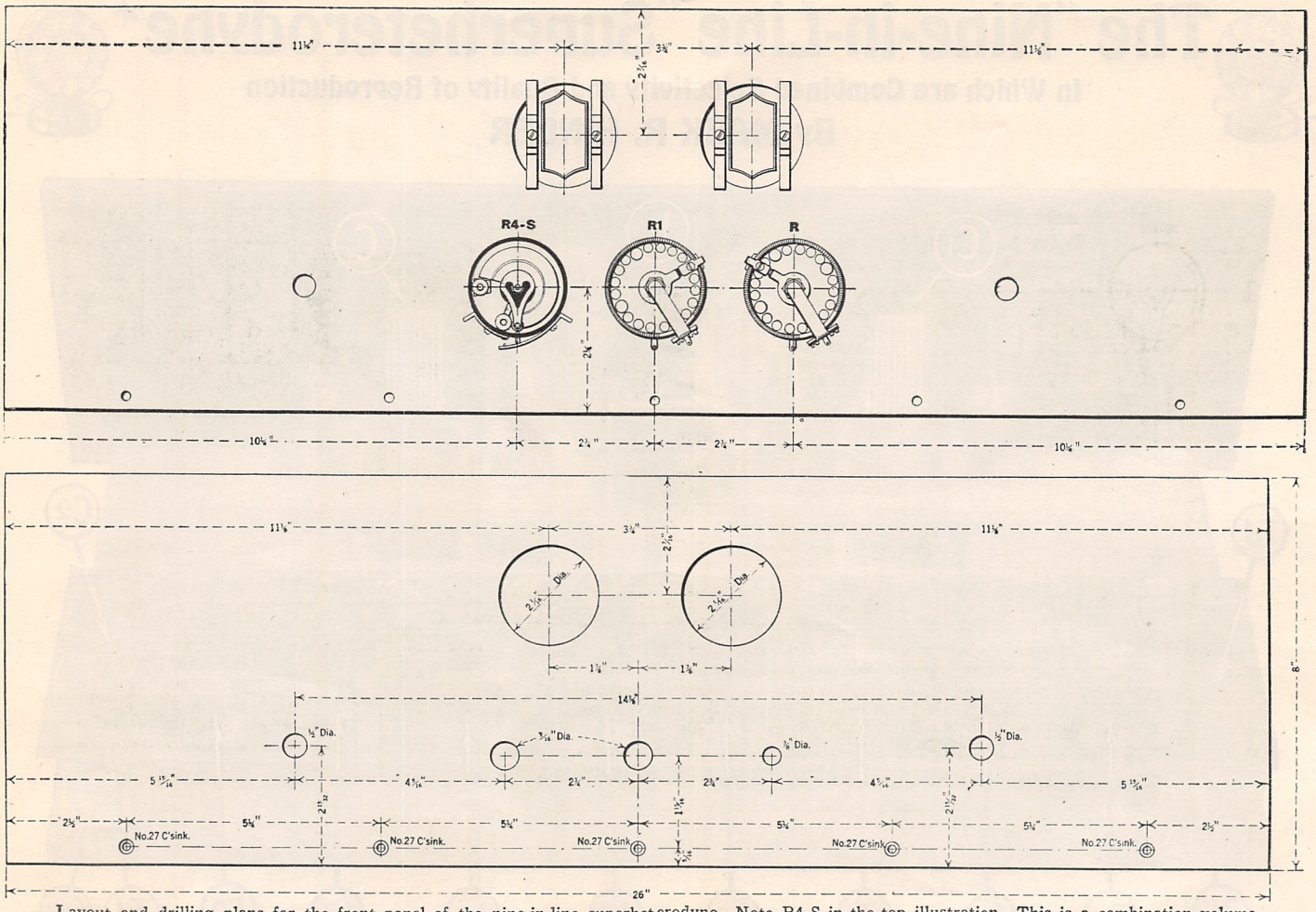


A side view of the completed receiver. This shows the details of the worm-gear vernier drive and drum-type indicator on each of the two variable condensers. The framework is cast aluminum. The symbols here are the same as in the illustration above. It will be noted that the two variable condensers are mounted on the wooden sub-base and are in no way supported by the panel. As a matter of fact, the panel carries none of the weight of the receiver, except for the rheostats and volume control, and consequently requires no bracing.

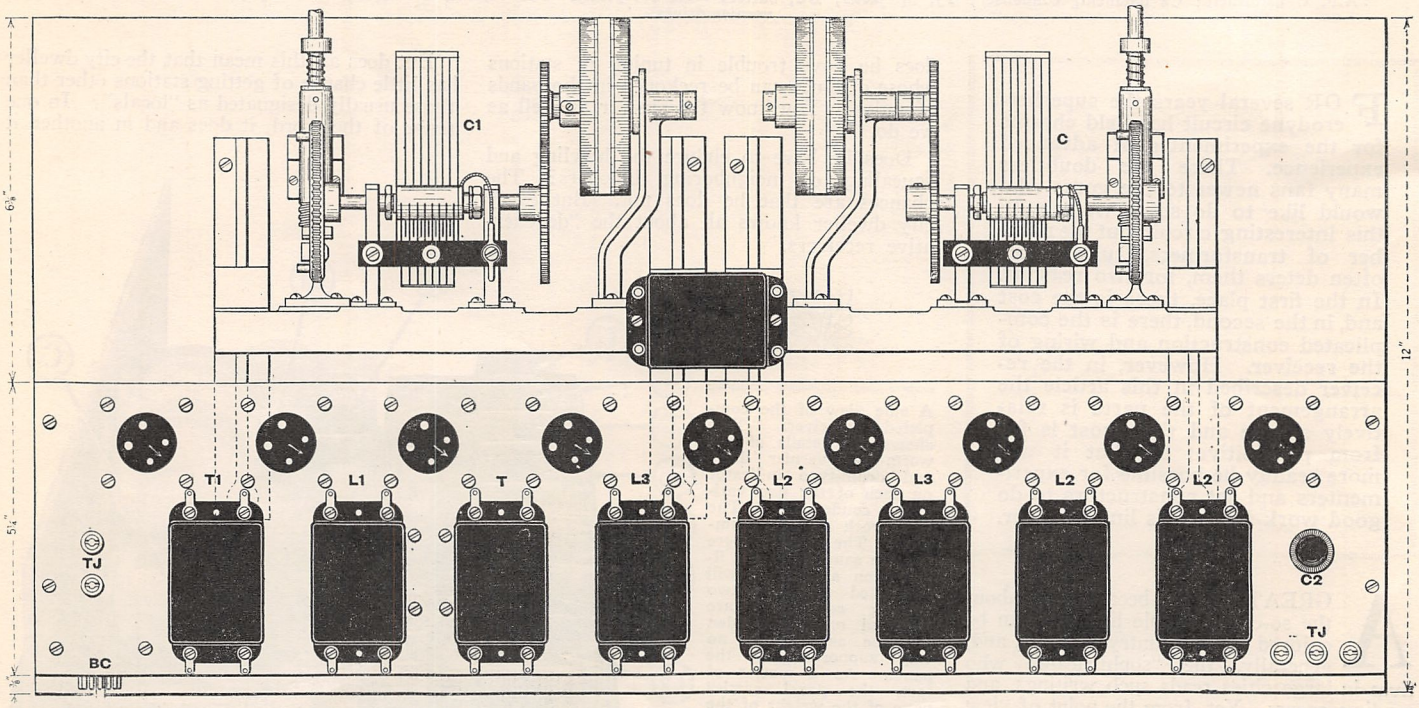
Photos by courtesy of the High Frequency Laboratories.

But does all this mean that the city dweller has little chance of getting stations other than those usually designated as "locals"? In one sense of the word, it does and in another it

* Radio News *Blueprint Article No.* 17.



Layout and drilling plans for the front panel of the nine-in-line superheterodyne. Note R4-S in the top illustration. This is a combination volume control for the audio amplifier and the filament switch.

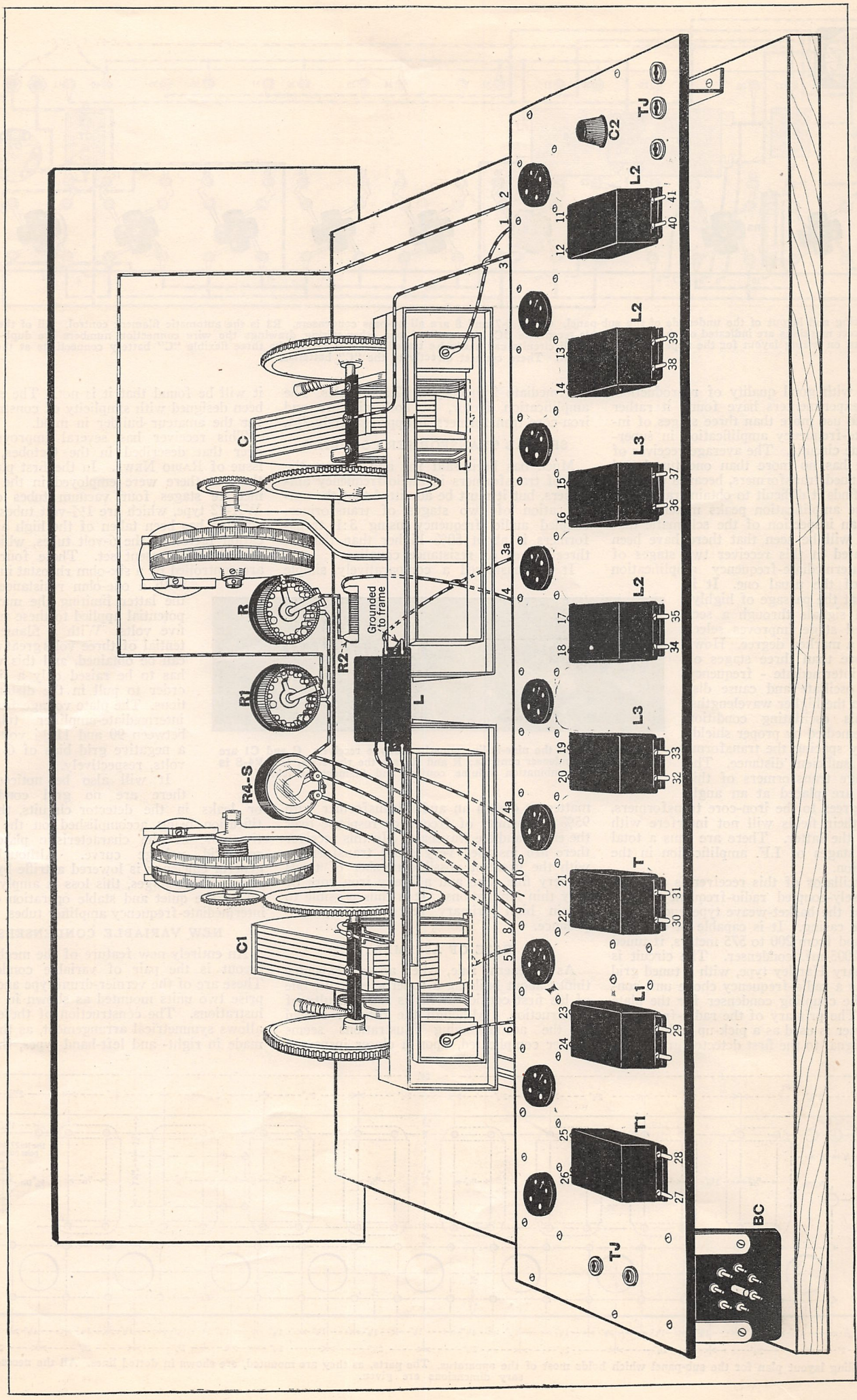


Layout of apparatus on the wooden sub-base. It will be noted that the variable condensers, in contrast to the usual practice, are not mounted on the panel. It is therefore important that they are lined up on the sub-base properly, so that the drum indicators will, in turn, line up with the special bezels on the panel. Drillings and dimensions for the sub-panel are given on page 1248.

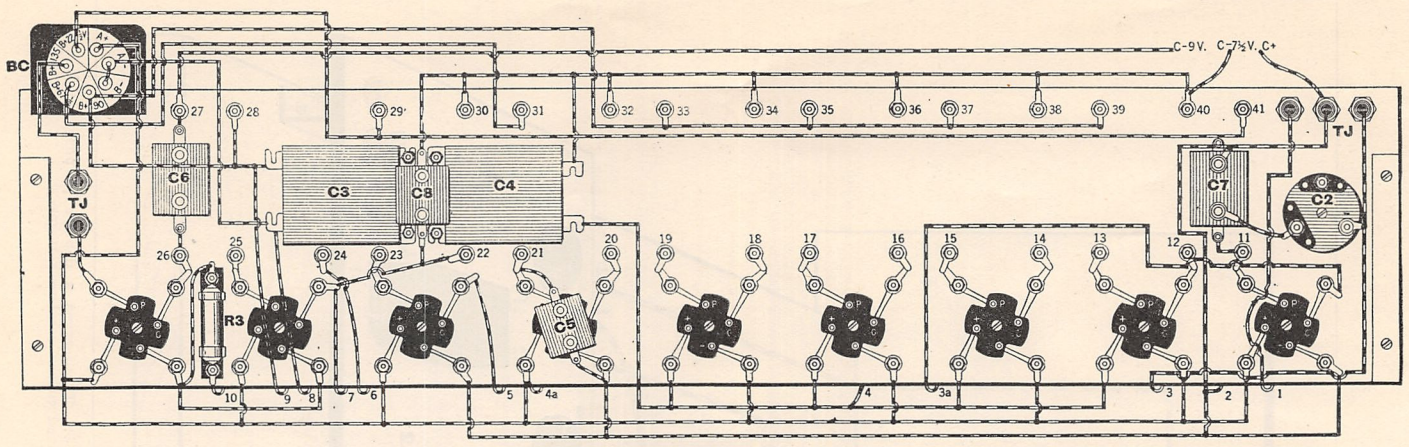
does not. In the first place, there are very few of the fans living in congested districts and using average receivers who get many distant stations, except those which are brought in after the locals have signed off. On the other hand, there are receivers with which it is entirely possible to tune out the locals and bring in the distant stations right "through" the ones near at hand.

A SET WHICH "GETS THROUGH"

To do this DX work it is necessary that a receiver be both very sensitive and very selective. When a receiver has these two features incorporated in its design, there is in many cases a corresponding absence of that characteristic known as "quality of reproduction." However, the set which is pictured on these pages is one in which this last characteristic is conspicuous. Not only will this superheterodyne bring in DX, but also bring



Layout and wiring of the upper part of the receiver. R and R1 are the filament rheostats. Note that there is a 1.0-ohm fixed resistance (R2) in series with rheostat R. This serves a definite purpose which is outlined in the article. R4-S is a combination of volume control and filament switch. Observe that one terminal on the R.F. transformer L is connected to the condenser frame.



Wiring and layout of the underside of the sub-panel. C3-4-5-6-7 and 8 are all by-pass condensers. R3 is the automatic filament control. All of the correct markings are indicated on the battery cable receptacle BC. As in all of our other wiring drawings the wire connection numbers are duplicated on wiring layout for the upper side; so that all circuits can easily be traced through. Note the three flexible "C" battery connections at the extreme right. These connect directly to the "C" batteries.

it all in with good quality of reproduction.

Most experimenters have found it rather difficult to use more than three stages of intermediate-frequency amplification in superheterodyne circuits. The average receiver of this type has no more than one tuned and three untuned transformers, because the constructor finds it difficult to obtain transformers whose amplification peaks match.

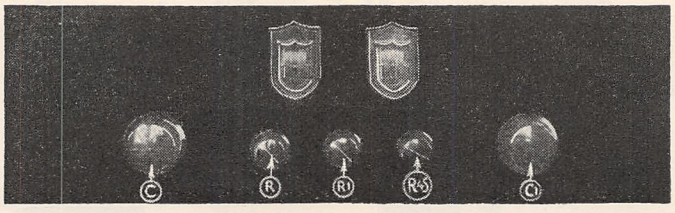
From an inspection of the schematic diagram, it will be seen that there have been incorporated in this receiver two stages of tuned intermediate-frequency amplification instead of the usual one. It is found that the passage of highly-amplified signals through a second tuned stage improves selectivity to a marked degree. However, more than three stages of tuned intermediate-frequency tend to oscillate and cause distortion on the higher wavelengths. Now this oscillating condition can be remedied by proper shielding or by spacing the transformers at a sufficient distance. The tuned-stage transformers of this receiver are placed at an angle of 90 degrees to the iron-core transformers, so that their fields will not interfere with those of the latter. There are thus a total of four stages of I.F. amplification in the combination.

The oscillator of this receiver is an ordinary closely-coupled radio-frequency transformer of the basket-weave type enclosed in a bakelite casing. It is capable of covering a waveband from 200 to 575 meters, if tuned with a .0005-mf. condenser. The circuit is the ordinary Hartley type, with a tuned grid as well as a radio-frequency choke unit containing the coupling condenser for the plate supply. The primary of the radio-frequency transformer is used as a pick-up coil, supplying the signal to the first detector grid. The intermediate frequency is 37,500 cycles. The amplification factor, of both air-core and iron-core transformers, is approximately 2½.

SPECIAL TRANSFORMER COUPLING

Much has been said for and against the use of transformers in audio-frequency amplifiers, but it must be admitted that the amplification of two stages of transformer-coupled audio frequency using 3:1 transformers is about 50% higher than that of three stages of resistance coupling.

It is considered a comparatively simple matter to design an audio transformer with 95% uniformity of frequency response over the entire audible waveband. In this receiver there are installed very small transformers with the greatest possible number of turns of very fine wire and a heavy iron core of very thin laminations. It is thus possible to obtain high primary and secondary impedance.



A panel view of the nine-in-line superheterodyne receiver. C and C1 are the variable condenser controls; R and R1 are the rheostats, and R4-S is the combination volume control and filament switch.

EASE OF ASSEMBLY

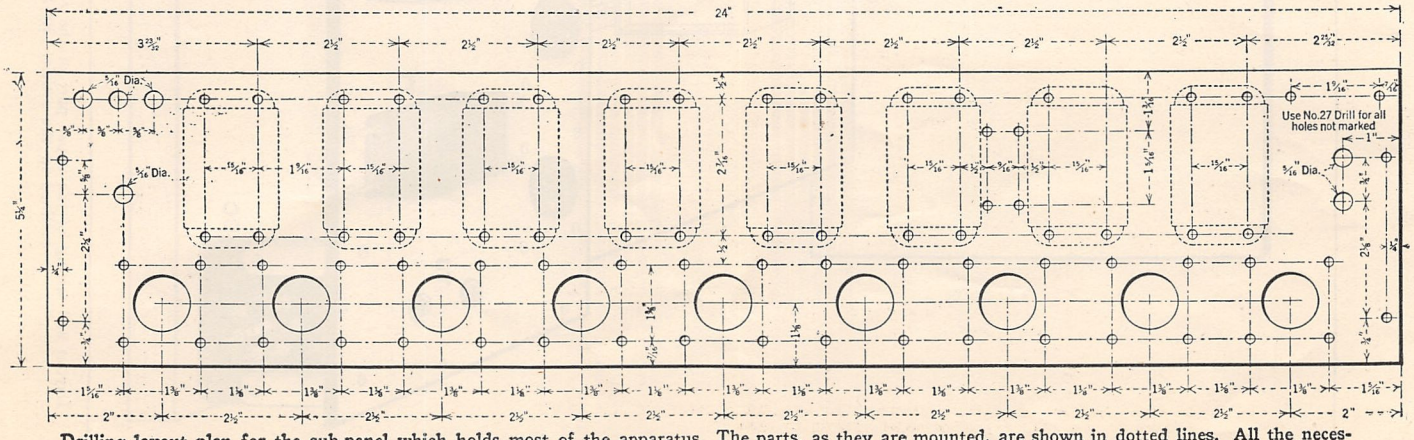
As a general rule, when an experimenter thinks about building a superheterodyne, one of his first considerations is the difficulty of construction. Although the receiver shown in the accompanying illustrations seems rather complicated, upon a closer inspection it will be found that it is not. The set has been designed with simplicity of construction for the amateur builder in mind.

This receiver has several improvements over that described in the October, 1926, issue of Radio News. In the first place, in that set there were employed in the intermediate stages four vacuum tubes of the WX-12 type, which are 1½-volt tubes. Advantage has been taken of the high amplification factor of the 6-volt tubes, which are used in the present set. These four tubes are controlled by a six-ohm rheostat in series with a one-ohm resistance strip, the latter limiting the maximum potential applied to these tubes to five volts. With a filament potential of three volts great volume can be obtained, and this voltage has to be raised only a little in order to pull in the distant stations. The plate voltage for these intermediate-amplifier tubes is between 90 and 112½ volts with a negative grid bias of 6 to 7½ volts, respectively.

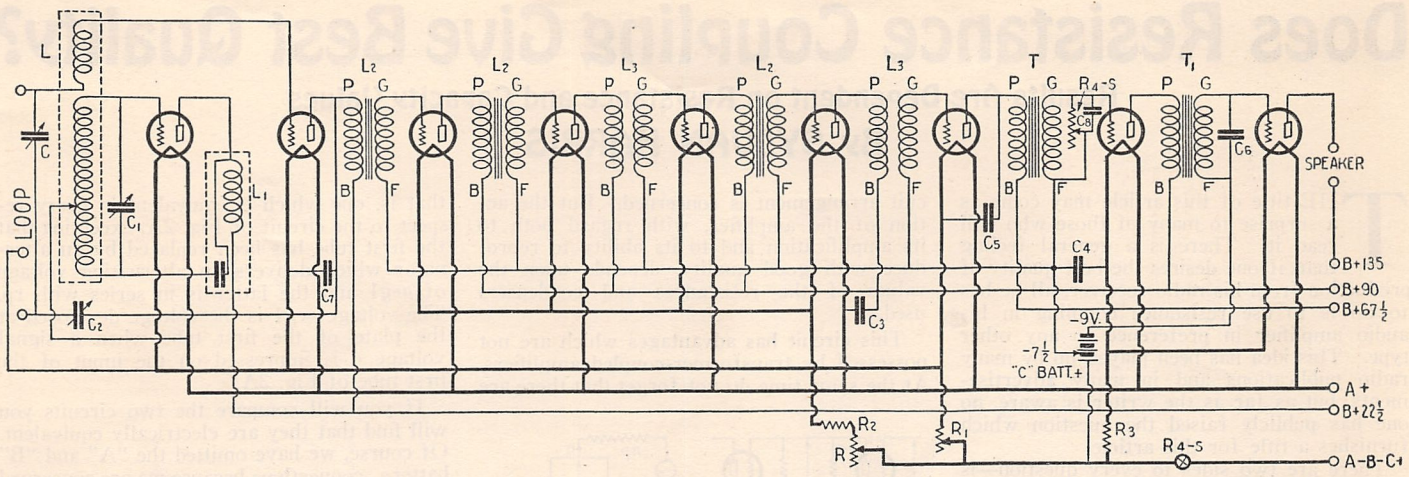
It will also be noticed that there are no grid condensers or leaks in the detector circuits, the rectification being accomplished on the negative side of the characteristic plate current-grid voltage curve. Although the general efficiency is lowered a trifle by biasing all these stages, this loss is amply made up by the quiet and stable operation of the intermediate-frequency amplifier tubes.

NEW VARIABLE CONDENSERS

An entirely new feature of the mechanical layout is the pair of variable condensers. These are of the vernier-drum type and comprise two units mounted as shown in the illustrations. The construction of these units allows symmetrical arrangement, as they are made in right- and left-hand types, the ver-



Drilling layout plan for the sub-panel which holds most of the apparatus. The parts, as they are mounted, are shown in dotted lines. All the necessary dimensions are given.



The schematic circuit diagram of the nine-in-line superheterodyne. Note that both the first and second detector tubes have their grids biased by a "C" battery. No grid condensers or leaks are used. The intermediate-frequency-transformers are staggered; there are two iron-cored, one air-cored, another iron-cored, and then a second air-cored, I.F. transformers. An R.F. choke (L1) is used in conjunction with the oscillator coupler (L). There are three loop connections, for a center-tap loop.

nier worm-gear shafts being placed opposite each other. The shaft of the right-hand condenser should be replaced with a ¼-inch bakelite or fiber rod in order to avoid body-capacity effects on this unit. It will be noticed also that the tuned-radio-frequency transformer used as an oscillator coupler is placed between the two tuning units on their frame, thus assuring extremely short radio-frequency connections.

All other apparatus is mounted on a 5½ x 24-inch bakelite base and wired according to the accompanying sketches. All connections between this base and the apparatus mounted on the front panel are made with flexible insulated wire; and these leads should be soldered to the base panel apparatus before the latter, with its brackets, is fastened to the baseboard. These leads should be left long enough to reach all respective terminals of the tuning and volume control instruments.

The volume controls, mounted in the center of the front panel, consist of two 6-ohm rheostats and one 200,000-ohm variable resistance. The left-hand rheostat, in series with the 1-ohm resistance strip, controls the filaments of the four intermediate-frequency amplifier tubes. The center rheostat governs the two detector and the oscillator tubes. The 200,000-ohm resistance at the right is in combination with a filament switch, the latter operating at the extreme left position of this unit.

Although this layout will require constructional experience, it will not occasion considerable difficulties in assembling, provided utmost care is observed in the proper placing of the condensers. In mounting these units it is necessary to use a square, in order to have the front of the drum flush with the front end of the baseboard. In this case the window frames will give the required clearance of the drums from the windows.

USE OF CONTROLS

One of the outstanding features is the vernier control of the tuning elements, as the selectivity of the receiver needs extremely fine tuning. The absence of carrier-wave whistles enables quiet operation. The left-hand rheostat, used as a general volume control, has to be operated according to the incoming signal strength; while the rheostat controlling the oscillator and two detector tubes will be a help in tuning to the lower-wave stations, where it can be used as additional vernier control for the oscillator tuner. The 200,000-ohm resistance across the secondary of the first audio transformer is used on nearby stations and is important for tone modulation. If this resistance is lowered the amplification of higher frequencies in the audio band will be decreased, thus allowing a predominance of low notes when this effect is desired.

Contrary to all expectations, this receiver has an exceedingly low "B" battery drain, so that ordinary dry "B" batteries will assure the most economical operation. The average drain per tube, except for the semi-power tube, is only 1.2 milliamperes.

Reports state that a clear ten-kilocycle separation of local broadcasters without sacrifice of tone is standard. According to verified statements, thirteen Pacific Coast stations were picked up on January 8, 1927, by Mr. Mott X. Corcoran of Valparaiso, Ind. At the time of this record twenty-three Chicago stations were on the air, these being located only thirty-five miles from the receiver. No doubt this selectivity is due to the perfect laboratory matching of the long-wave units and the use of two sharply-peaked filter stages.

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER★	
L	1	R. F. Trans.		Used as osc. coupler	1	
L1	1	R. F. Choke		(Special)	1	
L2	3	Long Wave Trans.	37 K.C.	Iron core (Special)	1	
L3	2	Long Wave Trans.	37 K.C.	Air Core (Special)	1	
C,C1	2	Var. Cond.	.0005 mf.	Drum type with framework	2	
C2	1	Var. Cond.	.000045 mf.	Midget type	3	6,13,14,15,16
C3,C4	2	Fixed Cond.	1.0 mf.	By-pass	2	4,17,18,19,20,21
C5,C6	2	Fixed Cond.	.002 mf.	By-pass	4	17,18,19,20,21
C7,C8	2	Fixed Cond.	.0005 mf.	By-pass	4	17,18,19,20,21
R,R1	2	Rheostats	6 ohms		5	4,7,14,17,18,22,23
R2	1	Fixed Resis.	1 ohm		5	4,22
R3	1	Auto. Fil. Control	5 v. ¾amp.		6	24,25,26
R4	1	Var. Resis.	0-200000ohm	With automatic switch	7	22
T,T1	2	A. F. Trans.		(Special)	1	
BC	1	Bat. Cable		Seven wire	5	27
TJ	5	Tip Jacks		For loop and loud speaker	5	22,28,29
	2	Brackets		(Special)	1	
	1	Panel		8" X 26" X 3/16"	9	30,31,32
	1	Sub-base		5½" X 24" X 3/16"	9	30,31,32
	1	Base-board		(Wood) 12" X 24" X 5/8"		
	1	Cabinet		8" X 26" X 13"	10	
	20ft.	Hook-up Wire			11	33,34
	8	Vac. Tubes	5 v. ¼amp.	Standard type	12	35,36,37,38,39,40
	1	Vac. Tube	5v. ½ amp.	Semi-power amplifier	12	35,36,37,38,39,40
	1	Loop Antenna			41	44,42

If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible difference in size from those originally used in laying out and drilling the panel and sub-base.

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 High Frequency Labs. (HFL)
2 Perlesz Radio Mfg. Co.
3 Chelten Elec. Co.
4 Leslie F. Muter Co.
5 Yaxley Mfg. Co.
6 Daven Radio Corp.
7 Central Radio Labs.
8 Benjamin Elec. Mfg. Co.
9 Diamond State Fibre Co.(Celeron)
10 Excello Products Corp.
11 Belden Mfg. Co.
12 Q.R.S. Music Co.
13 Hammarlund Mfg. Co.
14 General Radio Co.
15 Silver-Marshall, Inc.
16 Gardiner & Hepburn, Inc.
17 Electrad, Inc.
18 Polymet Mfg. Corp.
19 Aerovox Wireless Corp.
20 Sangamo Elec. Co.
21 Wireless Spec. Apparatus Co.
22 Carter Radio Co.
23 Herbert H. Frost, Inc.
24 Langbein-Kaufman Radio Co.(Elkay)
25 Int. Resis. Co. (Durham)
26 L. S. Brach Mfg. Co.
27 Howard B. Jones
28 Union Radio Co.
29 Brooklyn Metal Stamping Co.
30 Lignole Corp.
31 Amer. Hard Rubber Co.(Radion)
32 Formica Insulation Co.
33 Alpha Radio Supply
34 Acme Wire Co.
35 Van Horne Co.
36 Perryman Elec. Co.
37 C. E. Mfg. Co. (Ceco)
38 Magnavox Co.
39 Radio Corp. of America
40 E. T. Cunningham, Inc.
41 Radio Appliance Corp.
42 Bodine Elec. Co.
43 Alden Mfg. Co.
44 Duro Metal Products Co.

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★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

Does Resistance Coupling Give Best Quality?

Results Are Dependent on Resistance and Capacity Values

By SYLVAN HARRIS

THE title of this article may come as a surprise to many of those who will read it. There is a general feeling that, if one desires the best quality of production from his radio receiver, all he has to do is to use resistance coupling in his audio amplifier in preference to any other type. This idea has been played up by many radio publications and in many advertisements, but as far as the writer is aware, no one has publicly raised the question which furnishes a title for this article.

There are two sides to every question—is it so, or is it not? And, if not, then why not? These are questions which will be discussed in this article in connection with the resistance-coupled amplifier. The presentation of facts is based on a paper written by the present writer, published in the December, 1926, issue of *Proceedings of the I.R.E.*

ELEMENTS OF THE CIRCUIT

Before we discuss these questions, let us consider some of the advantages of resistance coupling. First of all, the circuit of a

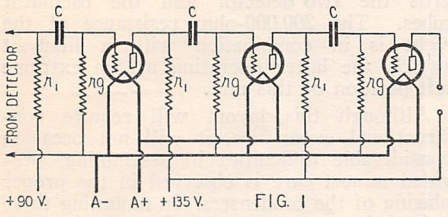


FIG. 1

The circuit diagram of a typical resistance-coupled audio-frequency amplifier.

complete resistance-coupled amplifier is shown in Fig. 1. The development of this type of amplifier has been described in detail in an article by the writer, entitled, "Types of Audio Amplifiers," published in the October, 1926, issue of RADIO NEWS. The plate current for the various tubes in the amplifier flows through resistances marked r1 in the diagram. In order to prevent the high positive voltage of the "B" battery from charging the grids of the succeeding tubes, it is necessary to use blocking condensers, marked C in Fig. 1. Then, since this would leave the grids of the tubes "free," it is necessary to connect across the grid and filament of each tube a grid-leak resistance, marked rg in the diagram. This completes the amplifier, as far as the circuit arrangement is concerned. But the action of the amplifier, with regard both to its amplification and to its ability to reproduce with good quality, depends upon the values of the resistances and condensers used.

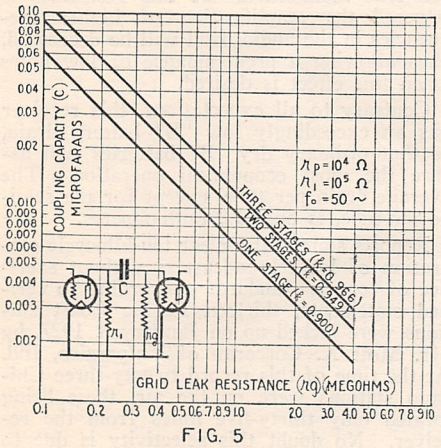


FIG. 5

The curves show the relation between the grid-leak resistance and the capacity required for "distortionless" amplification.

This circuit has advantages which are not possessed by transformer-coupled amplifiers. At the same time do not forget that there are

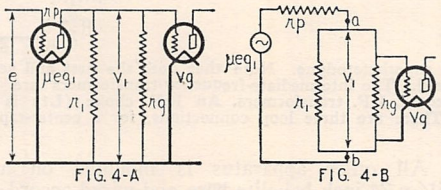


FIG. 4-A FIG. 4-B

When the capacity of C (Fig. 2A) is high or the frequency is high, then the diagrams of Fig. 2 become those above.

advantages possessed by transformer-coupled amplifiers and not by resistance-coupled amplifiers. A very important advantage of the resistance amplifier is the fact that there are no such things as resonance peaks, which often occur in transformers having considerable coil capacity.

Another advantage is that the resistances r1 and rg (Fig. 1) function independently of the frequency. In transformers, at very low frequencies, say 60 cycles, the impedance is very much lower than the impedance at higher frequencies, say 1,000 cycles. Consequently the bass notes of the organ or other music are not amplified as much as the high notes, and in some cases are lost altogether. This matter has been discussed in great detail by the writer in his series of articles on amplifiers in general, in RADIO NEWS.

SOME DISADVANTAGES

Such are the claims for all resistance-coupled circuits, but there are features which are too often neglected. One of the most important of these is that the presence of the blocking condenser in the circuit makes the resistance-coupled amplifier susceptible to a drop in amplification at the low frequencies of the bass notes, just the same as that we encounter in the transformers. We will understand how important this is, later on, and will find that in order to obtain good reproduction it is necessary to use much larger condensers than are ordinarily provided for resistance-coupled amplifiers.

The resistance-coupled amplifier has other disadvantages which must be weighed against its advantages, besides the important one mentioned. One of these is the low amplification, per stage, which is possible. The maximum amplification *theoretically* obtainable is equal to the voltage amplification factor of the tube. Using the 201A type of tube, therefore, the most we could ever hope to get in the way of amplification per stage is about 7, as contrasted with from 20 to 30 for the transformer-coupled amplifier.

ANALYSIS OF THE ACTION

Of course it is not possible to obtain the maximum theoretical amplification. The actual amplification is always lower than this. We can see why if we look at Fig. 2. In Fig. 2A we have shown one stage of the resistance-coupled amplifier of Fig. 1. In this circuit is indicated the plate resistance of the tube, which is marked rp. Alongside, in Fig. 2B, is shown the equivalent circuit, that is, one which is equivalent in every respect to the circuit of Fig. 2A, excepting that the first tube has been replaced by an alternator which delivers an alternating voltage of μeg1 and the latter is in series with rp. The voltage μeg1 is the voltage developed at the plate of the first tube when a signal voltage e is impressed on the input of the first tube of Fig. 2A.

If you will compare the two circuits you will find that they are electrically equivalent. Of course, we have omitted the "A" and "B" battery connections because we are concerned only with the action of the alternating voltages. Now we are interested in comparing the value of the grid voltage on the second tube with that of the voltage developed in the plate of the first tube. That is, we want vg. to be as large as possible compared with μeg1. It is evident that vg can never be as as great as μeg1.

We shall see why directly. In the first place it will be seen that the voltage impressed on the second tube, vg, is only a part of the voltage across the resistance rg and the

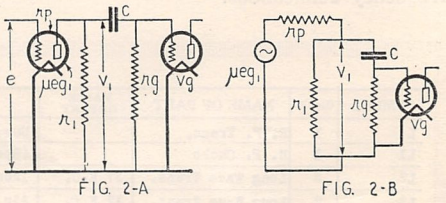


FIG. 2-A FIG. 2-B

These circuits are the equivalent of a single stage of the amplifier in Fig. 1.

condenser C. This voltage is marked V1 in Fig. 2B. The reason for this is that part of the voltage V1 is used up in the condenser C, where it does no good. The only voltage that does any good is that which gets to the input of the second tube.

Going a step further we notice that the voltage V1 is only a part of the total voltage developed at the plate of the first tube (μeg1), for a part of the total voltage is used up in the plate resistance rp of that tube. It is evident, therefore, that there is no amplification in the coupling device, but on the contrary there is attenuation; which is a polite way of saying that there is a loss instead of a gain. We amplify, say, seven times in the tube, and then lose perhaps 20 per cent. of this in the coupling device, bringing our net amplification per stage down to perhaps five or a little more. The ampli-

(*Continued on page* 1297)

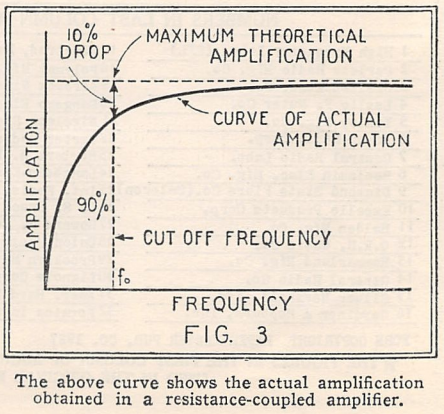


FIG. 3

The above curve shows the actual amplification obtained in a resistance-coupled amplifier.

Letters from Home Set Constructors

THE SET BUILDER'S PROGRESS

Editor, RADIO NEWS:

I wonder if the manufacturers realize the business-creating force of a publication like RADIO NEWS? Take my case for instance: in December, 1925, a friend introduced me to his two-tube set and to RADIO NEWS of that month. That issue contained the "Regenerative Interflex" story. I built this receiver. The following one contained Mr. Harris' "Balanced Regenerator" story, and I built that set also with good success, as I had done with the Interflex.

A little later a friend told me very enthusiastically of results he was getting with a Browning-Drake hook-up; and just then you published a B.-D. constructional article. So I tried that one also. Since that time I have made up four of these sets for friends who are, I believe, "in radio" solely by reason of having caught the germ from me.

Of course, all of this activity means the marketing of quite a little radio merchandise, and all from a little spark kindled by RADIO NEWS.

I am now using a set consisting of the Harris Balanced Regenerative Detector, preceded by a tickler reversed-feedback stage and with two transformer-coupled A.F. stages following; and this I think the best of the four-tube hook-ups.

C. E. LLOYD,
R. F. D. 1, Spokane, Wash.

HOW GEORGE DID IT

Editor, RADIO NEWS:

Looking over your January issue, I came across the story "The Invisible Net." After reading it, I thought of a little outfit I have attached to my receiving set. I am enclosing a diagram of the hook-up; it is a regular two-tube amplifier. The microphone is an ordinary 1500-ohm telephone receiver. At the output of the amplifier is a D.P.D.T. switch, so that either the receiving set or the miniature "broadcaster" can be connected to the horn.

As I am an experimenter by nature and a radio repair and service man by trade, I have a chance once in a while to make up something of this sort. I have a Browning-Drake receiver—which is very popular in this district—and this outfit all in the same cabinet. I have used this at five church entertainments.

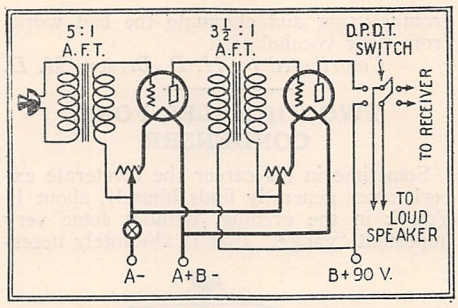


Diagram of Mr. Greenlaw's first hook-up; the "mike" is a common 1500-ohm phone receiver.

The diagram shows the outfit as originally made up, but I have since changed it so that I can connect either of two microphones; one at the set for the operator, and one in another room made up as a studio. Also I have a set of earphones connected with the horn so that the operator can listen to what is going to the horn. I have also two small switches to cut out either the earphones or the horn. At the entertainments I used a loud speaker that looks like a microphone for the studio microphone of the outfit. If the loud speaker is connected to the input of the outfit diagramed, conversation from the room where the loud speaker is can easily be heard. Hoping this will enlighten some of the readers of "The Invisible Net."

A. W. GREENLAW,
51 *Willard St., Malden, Mass.*

THE FILADYNE CIRCUIT

Editor, RADIO NEWS:

Just a line or two that may let the people back in the old country know that we get quite a bit of information from RADIO NEWS. Being a bunch of freshly-graduated amateurs from the division radio school, we try almost any old hook-up. And one we tried is the Filadyne circuit appearing in the November issue of RADIO NEWS. There were no data given, but we went ahead and made it. And it worked fine, using about 85 turns of No. 21 D.C.C. wire on the primary and secondary, 130 turns of No. 26 D.C.C. for the chokes; also VT1 tube, .0025-mf. fixed condenser across the phones, these having 1000 ohms D.C. resistance. Had 45 volts on plate and 4 volts on filament.

(*Continued on page* 1270)

LIST OF BROADCAST STATIONS IN THE UNITED STATES

(*Continued from page* 1216)

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
WJBW	New Orleans, La.	270	20
WJBY	Gadsden, Ala.	270.1	150
WJBZ	Chicago Heights, Ill.	419.3	100
WJJD	Mooseheart, Ill.	*370.2	1000
WJPW	Ashtabula, Ohio	239.9	15
WJR	!Pontiac, Mich.	516.9	5000
WJUG	New York, N. Y.	516.9	250
WJZ	!Bound Brook, N. J.	*454.3	50000
WKAF	Milwaukee, Wis.	261	750
WKAQ	San Juan, P. R.	*340.7	500
WKAR	East Lansing, Mich.	285.5	1000
WKAV	Laconia, N. H.	223.8	100
WKBA	Chicago, Ill.	209.7	200
WKBB	Joliet, Ill.	282.8	100
WKBG	Birmingham, Ala.	225	10
WKBE	Webster, Mass.	270.1	100
WKBF	Indianapolis, Ind.	244	100
WKBG	Chicago, Ill. (portable)	215.7	100
WKBH	La Crosse, Wis.	249.9	500
WKBI	Chicago, Ill.	220.4	50
WKBJ	St. Petersburg, Fla.	280	250
WKBL	Monroe, Mich.	252	15
WKBM	Newburgh, N. Y.	285.5	100
WKBN	Youngstown, Ohio	360	50
WKBO	Jersey City, N. J.	220.4	500
WKBP	Battle Creek, Mich.	290	100
WKBQ	New York, N. Y.	285	8
WKBS	Galesburg, Ill.	361.2	200
WKBT	New Orleans, La.	252	50
WKBU	New Castle, Pa. (port.)	238	50
WKBV	Brookville, Ind.	236.1	250
WKBW	Buffalo, N. Y.	362.5	5000
WKBX	Harrisburg, Pa.		
WKBY	Danville, Pa. (port.)	220	100
WKBZ	Ludington, Mich.	256.3	15
WKDR	!So. Kenosha, Wis.	428.3	
WKIC	Lancaster, Pa.	258	50
WKRC	Cincinnati, Ohio	325.9 & 422.3	2500
WKY	Oklahoma City, Okla.	352.7	100
WLAC	Nashville, Tenn.	225.4	1000
WLAL	Tulsa, Okla.	250	100
WLAP	Louisville, Ky.	275	20
WLB	Minneapolis, Minn.	277.6	500
WLBC	Muncie, Ind.	223.7	
WLBE	Brooklyn, N. Y.	230.6	
WLBF	Kansas City, Mo.	211.1	25
WLBH	Farmingdale, N.Y. (port.)	230	30
WLBG	Petersburg, Va.	332.3	100
WLBI	East Wenona, Ill.	296.9	250
WLBJ	Cleveland, Ohio	300	100
WLBL	!Stevens Point, Wis.	278	750
WLBM	Boston, Mass.	480	50
WLBN	Chicago, Ill. (port.)	225.4	5
WLBO	Galesburg, Ill.	243	100
WLBP	Ashland, Ohio	220.4	15
WLBQ	Atwood, Ill.	230.6	25
WLBR	Belvedere, Ill.	335	15
WLBT	Crown Point, Ind.	230	100
WLBU	Canastota, N. Y.	220	5
WLBV	Mansfield, O.	230.6	50
WLBW	Oil City, Pa.	321	250
WLBX	Long Island City, N.Y.	230.6	250
WLBY	Iron Mountain, Mich.	249.9	50
WLBZ	Dover-Foxcroft, Me.	299	250
WLCI	Ithaca, N. Y.	266	50
WLIB	!Elgin, Ill.	302.8	4000
WLIT	Philadelphia, Pa.	394.5	500
WLS	!Crete, Ill.	*344.6	5000
WLSI	Edgewood, R. I.	440.9	500
WLTS	Chicago, Ill.	258	100
WLW	!Harrison, Ohio	*422.3	5000
WLWL	New York, N. Y.	384.4	5000
WMAC	Cazenovia, N. Y.	275	100
WMAF	Dartmouth, Mass.	440.9	1000
WMAK	Lockport, N. Y.	265.3	1000
WMAL	Washington, D. C.	293.9	500
WMAN	Columbus, Ohio	227.6	50
WMAQ	Chicago, Ill.	*447.5	1000
WMAY	St. Louis, Mo.	248	100
WMAZ	Macon, Ga.	261	500
WMBA	Newport, R. I. (port.)	249.9	100
WMBB	Chicago, Ill.	250	500
WMBC	Detroit, Mich.	256.4	100
WMBD	Peoria Heights, Ill.	379	250
WMBE	St. Paul, Minn.	220	5
WMBF	Miami Beach, Fla.	384.4	500
WMBG	Richmond, Va.	220	10
WMBH	Chicago, Ill. (port.)	280	100
WMBI	Chicago, Ill.	288.3	500
WMBJ	Monessen, Pa.	277.6	50
WMBK	Hamilton, O.	360	10
WMBL	Lakeland, Fla.	410	10
WMBM	Memphis, Tenn.	245	10
WMBO	Auburn, N. Y.	238	200
WMBQ	Brooklyn, N. Y.	210	100
WMBR	Tampa, Fla.	250	100
WMBS	Harrisburg, Pa.	360	500
WMBU	Pittsburgh, Pa.	236.1	50
WMBW	Youngstown, O.	279	50
WMBX	Columbus, Miss.	265.3	100
WMBY	Bloomington, Ill.	291.1	15
WMC	Memphis, Tenn.	499.7	500
WMCA	!Hoboken, N. J.	340.7	500
WMHA	New York, N. Y.	230	30
WMPC	Lapeer, Mich.	202	30
WMRJ	Jamaica, N. Y.	227.1	10
WMSG	New York, N. Y.	502.8	500
WMVM	Newark, N. J.	475.9	500
WNAB	Boston, Mass.	280.2	100
WNAC	Boston, Mass.	430.1	500
WNAD	Norman, Okla.	254	500
WNAL	Omaha, Nebr.	258	500
WNAT	Philadelphia, Pa.	250	500
WNAX	Yankton, S. Dak.	244	100
WNBA	Forest Park, Ill.	238	500
WNBF	Endicott, N. Y.	205.4	50
WNBH	New Bedford, Mass.	248	250
WNJ	Newark, N. J.	350	150
WNOX	Knoxville, Tenn.	267.7	500
WNRC	Greensboro, N. C.	223.7	10
WNYC	New York, N. Y.	526	1000
WOAI	San Antonio, Tex.	394.5	5000
WOAN	Lawrenceburg, Tenn.	356.4	500
WOAX	Trenton, N. J.	240	500
WOBB	Chicago, Ill.	555.2	5
WOC	Davenport, Iowa	*483.6	5000
WOCB	Orlando, Fla.	293.7	250
WOCL	Jamestown, N. Y.	275.2	15
WODA	Paterson, N. J.	390.7	1000
WOI	Ames, Iowa	*270.1	750
WOK	!Homewood, Ill.	410	20000
WOKO	Peekskill, N. Y.	233	50
WOKT	Rochester, N. Y.	340	1000
WOMT	Manitowoc, Wis.	254.1	50
WOO	Philadelphia, Pa.	508.2	500
WOOD	Fernwood, Mich.	242	1000
WOQ	Kansas City, Mo.	278	1000
WOR	Newark, N. J.	405.2	500
WORD	!Batavia, Ill.	275	5000
WOS	Jefferson City, Mo.	440.9	500
WOW	Omaha, Neb.	526	1000
WOWO	Fort Wayne, Ind.	*227	1200
WPAB	Norfolk, Va.	319	100
WPAK	Fargo, N. Dak.	275.1	50
WPAP	Cliffside, N. J.	361.2	100
WPCC	Chicago, Ill.	258	500
WPCH	New York, N. Y.	273	500
WPDQ	Buffalo, N. Y.	*205.4	100
WPEP	Waukegan, Ill.	221.6	500
WPG	Atlantic City, N. J.	299.8	5000
WPRC	Harrisburg, Pa.	215.7	100
WPSC	State College, Penna.	220.7	500
WPSW	Philadelphia, Pa.	236.1	50
WQAA	Parkesburg, Pa.	230	500
WQAE	Springfield, Vt.	246	50
WQAM	Miami, Fla.	285.5	750
WQAN	Scranton, Pa.	250	100
WQAO	!Cliffside, N. J.	361.2	100
WQJ	Chicago, Ill.	447.5	1000
WRAF	Laporte, Ind.	223.7	100
WRAH	Providence, R. I.	235	450
WRAK	Escanaba, Mich.	256.3	100
WRAL	Ithaca, N. Y.	365	25
WRAM	Galesburg, Ill.	244	100
WRAV	Yellow Springs, Ohio	263	100
WRAW	Reading, Pa.	238	100
WRAX	Philadelphia, Pa.	267.7	500
WRBC	Valparaiso, Ind.	278	500
WRC	Washington, D. C.	*468.5	1000
WRCO	Raleigh, N. C.	252	100
WREA	Shillington, Pa.	300	350
WREC	!Whitehaven, Tenn.	254	10
WREO	Lansing, Mich.	285.5	500
WRHM	Minneapolis, Minn.	252	1000
WRK	Hamilton, Ohio	270	100
WRM	Urbana-Champaign, Ill.	272.6	1000
WRMU	Richmond Hill, N.Y. (port.)	236	100
WRNY	!Coytesville, N. J.	373.8	500
WRR	Dallas, Texas	246	500
WRRS	Racine, Wis.	360	10
WRSC	Chelsea, Mass.	270.1	15
WRST	Bay Shore, N. Y.	215.7	150
WRVA	Richmond, Va.	256	1000
WSAI	!Norwood, O.	325.9	5000
WSAJ	Grove City, Pa.	229	250
WSAN	Allentown, Pa.	229	100
WSAR	Fall River, Mass.	322	100
WSAX	Chicago, Ill. (port.)	268	100
WSAZ	Pomeroy, Ohio	244	50
WSB	Atlanta, Ga.	428.3	1000
WSBC	Chicago, Ill.	288.3	1500
WSBF	St. Louis, Mo.	273	250
WSBT	South Bend, Ind.	315.6	500
WSDA	New York, N. Y.	263	250
WSEA	Virginia Beach, Va.	516.9	500
WSIX	Springfield, Tenn.	250	150
WSKC	Bay City, Mich.	*260.7	500
WSM	Nashville, Tenn.	282.8	5000
WSMB	New Orleans, La.	319	500
WSMH	Owosso, Mich.	240	20
WSMK	Dayton, Ohio	275	500
WSOE	Milwaukee, Wis.	246	500
WSOM	New York, N. Y.	288.3	500
WSRO	Hamilton, Ohio	252	100
WSSH	Boston, Mass.	261	100
WSUI	Iowa City, Iowa	483.6	500
WSVS	Buffalo, N. Y.	218.8	50
WSYR	Syracuse, N. Y.	352.7	500
WTAD	Quincy, Ill.	236	50
WTAG	Worcester, Mass.	545.1	500
WTAL	Toledo, Ohio	252	100
WTAM	Cleveland, Ohio	*389.4	3500
WTAQ	Eau Claire, Wis.	254	1000
WTAR	Norfolk, Va.	261	100
WTAS	!Batavia, Ill.	275.1	5000
WTAW	College Station, Texas	270	500
WTAX	Streator, Ill.	231	50
WTAZ	Lambertville, N. J.	261	15
WTHO	Ferndale, Mich.	407	500
WTIC	Hartford, Conn.	*475.9	500
WTRC	New York, N. Y.	239.9	100
WTRL	Midland Park, N. J.	280.2	15
WWAE	Chicago, Ill.	241.8	10000
WWJ	Detroit, Mich.	*352.7	1000
WWL	New Orleans, La.	275	100
WWNC	Asheville, N. C.	254	100
WWRL	Woodside, N. Y.	258.5	100
WWVA	Wheeling, W. Va.	348.6	100
2XAD	Schenectady, N. Y.	22.6-26.2	1000
2XAF	Schenectady, N. Y.	32.79	1000w
WRES	Wollaston, Mass.	295	50
WRHF	Washington, D. C.	256	50

LIST OF CANADIAN BROADCAST STATION CALLS

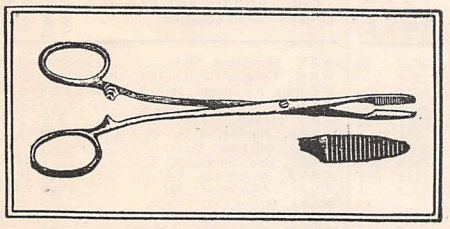
CFAC	Calgary, Alta.	434.5	500
CFCA	Toronto, Ont.	356.9	500
CFCF	Montreal, Que.	410.7	1650
CFCH	Iroquois Falls, Ont.	499.7	250
CFCK	Edmonton, Olta.	516.9	50
CFCN	Calgary, Alta.	434.5	1800
CFCQ	Vancouver, B. C.	410.7	10
CFCT	Victoria, B. C.	329.5	500
CFCY	Charlottetown, P. E. I.	312.3	50
CFDC	Vancouver, B C.	410.7	10
CFGC	Brantford, Ont.	296.9	50
CFJC	Kamloops, B. C.	267.7	15
CFLC	Prescott, Ont.	296.9	50
CFMC	Kingston, Ont.	267.7	20
CFQC	Saskatoon, Sask.	329.5	500
CFRC	Kingston, Ont.	267.7	500
CFYC	Burnaby, B. C.	410.7	500
CHCO	Huntsville, Ont.	247.8	5
CHCS	Hamilton, Ont.	340.7	10
CHCY	Edmonton, Alta.	516.9	250
CHIC	Toronto, Ont.	356.9	500
CHLC	Summerside, P. E. I.	267.7	25
CHNC	Toronto, Ont.	356.9	500
CHNS	Halifax, N. S.	322.4	100
CHRC	Quebec, Que.	340.7	5
CHUC	Saskatoon, Sask.	329.5	500
CHWC	Regina, Sask.	312.3	15
CHXC	Ottawa, Ont.	434.5	250
CHYC	Montreal, Que.	410.7	750
CJBC	Toronto, Ont.	291.1-356.9	500
CJCA	Edmonton, Alta.	516.9	500
CJCF	Kitchener, Ont.	247.8	25
CJCI	Toronto, Ont.	291.1	
CJCQ	York, Ont.	291.1	1000
CJGC	London, Ont.	329.5	500
CJOC	Lethbridge, Alta.	267.7	50
CJOR	Sea Island, B. C.	291.1	50
CJRM	Moose Jaw, Sask.	296.9	50
CJSC	Toronto, Ont.	356.9	500
CJTC	Calgary, Alta.	434.5	250
CJWC	Saskatoon, Sask.	329.5	250
CJYC	Scarboro, Ont.	291.1	500
CKAC	Montreal, Que.	410.7	1200
CKCD	Vancouver, B. C.	410.7	1000
CKCI	Quebec, Que.	340.7	23
CKCK	Regina, Sask.	312.3	500
CKCL	Toronto, Ont.	356.9	500
CKCO	Ottawa, Ont.	434.5	100
CKCR	St. George, Ont.	267.7	25
CKCV	Quebec, Que.	340.7	50
CKCW	Burketon Junction, Ont.	329.5	5000
CKCX	Toronto, Ont.	291.1	500
CKFC	Vancouver, B. C.	410.7	50
CKMC	Cobalt, Ont.	247.8	5
CKNC	Toronto, Ont.	356.9	500
CKOC	Hamilton, Ont.	340.7	50
CKPC	Preston, Ont.	247.8	8
CKSH	St. Hyacinthe, Que.	312.3	50
CKY	Winnepeg, Man.	384.4	500
CNRA	Moncton, N. B.	322.4	500
CNRC	Calgary, Alta.	434.5	500
CNRE	Edmonton, Alta.	516.9	500
CNRM	Montreal, Que.	410.7	1650
CNRO	Ottawa, Ont.	434.5	500
CNRR	Regina, Sask.	312.3	500
CNRS	Saskatoon, Sask.	329.5	500
CNRT	Toronto, Ont.	356.9	500
CNRV	Vancouver, B. C.	291.1	500
CNRW	Winnipeg, Man.	384.4	500

*Standard or constant frequency.
!Location of transmitter only.

SURGEON'S FORCEPS HANDY

It is said that radio has contributed something to surgery, especially in making possible the care of the sick at sea under the direction of the surgeon on land. So it is fitting that surgery should contribute something to radio; in fact it can contribute to the radio set builder the very best tool he can have in his kit-box. I refer to the surgical instrument known as the Murphy-Pean hemostatic forceps. This is an instrument in common use by surgeons for grasping bleeding vessels. It is inexpensive and can be readily obtained from the nearest surgical instrument dealer, or may be ordered through any druggist.

This instrument has many advantages over all pliers or similar tools used for radio construction. It is 6½ inches long, of light weight, rather flexible, but very strong. The blades are serrated, thus enabling it to grasp and hold tightly any object of small size, whether it be round, square or flat. Even round, smooth objects, which ordinary pliers



The hemostatic forceps used by surgeons will be found to be a handy tool to have in the set-constructor's tool-box.

will not even pick up, can be grasped very firmly. The size, contour and rough surface of the jaws adapt them especially for turning down firmly and with the greatest ease the thumb-nuts on terminals, with a sort of pipe-wrench effect.

Lengths of bus-wire or other objects to be soldered can be held firmly in any position. It will be noted from the accompanying illustration that the handles are provided with a spring lock. Thus any object grasped is immediately locked in a strong grip, if desired, and can be quickly released by a slight side-pressure on the handles. This is very useful in soldering, as two or more objects can be held and locked in the position desired, leaving both hands free for handling the iron and the solder.

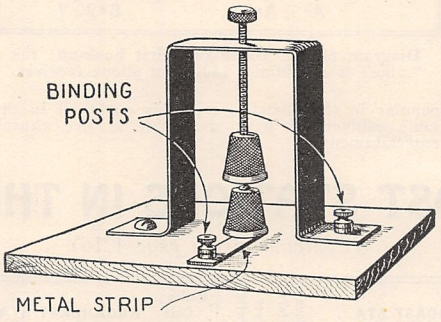
The instrument has many other uses. It can grasp a screw by the head and start it in a hole far down in the bottom of the works, even through a maze of wires. Or a screw can be grasped by the shank or head and shoved into the narrowest crevice to be started on its way. It can reach like a strong, slim hand into the deepest and most inaccessible places and pick out any small object. Terminal nuts can be tightened, removed or replaced in the most awkward situations with ease.

The instrument is not adapted to bending heavy bus-wire; but for every other purpose for which pliers are used about a radio set it is vastly better than the ordinary pliers of commerce. I assure radio fans that this is a radio wrinkle which will work for them and pay its way every time there is wiring or adjusting to do. It will save them much time, keep their dispositions from souring and eliminate the bad words from their vocabularies.

Contributed by H. B. Beeson, M. D.

TWO THIMBLES FORM CONDENSER

Sometime in his career the inveterate experimenter generally finds himself, about 11 o'clock in the evening, without some very important "gadget" that is absolutely neces-



With two thimbles, a strip of thin brass and a few odds and ends, an excellent low-capacity variable condenser can be made

sary to carry out the work on hand. Therefore, if you should encounter such a problem and happen to need a small-capacity variable condenser, here is one that can be made easily and quickly.

Two sewing thimbles (of the advertising variety, stamped from aluminum), are used. A hole is drilled through the top of one of them, to take a piece of 1/16 threaded brass rod, which is fastened in place by two nuts. A hole is drilled also in the top of the second thimble. A bolt is passed through this and through a piece of insulating material, which forms the base of the instrument. A piece of brass is bent into a U-shaped bracket, as shown, and three holes drilled in it, one in the bend and the others in each end, for mounting purposes. A nut to take the threaded brass rod is then soldered over the hole in the top of the cross-piece. This hole and nut allow the raising and lowering of the upper thimble in respect to the lower one. A binding post can be fastened to the end of the threaded rod for use as a handle. All the insulation necessary between the two thimbles is a heavy coat of shellac on the lower one. This prevents a short-circuit in case the upper thimble is lowered too far and touches the bottom one.

In order to make connections to the two plates of this condenser, one wire is connected to one of the screws holding the square bracket, and another to the metal strip which is fastened beneath the edge of the thimble mounted on the base. This strip can be made of several thicknesses of tinfoil, brought out to a binding-post on the base.

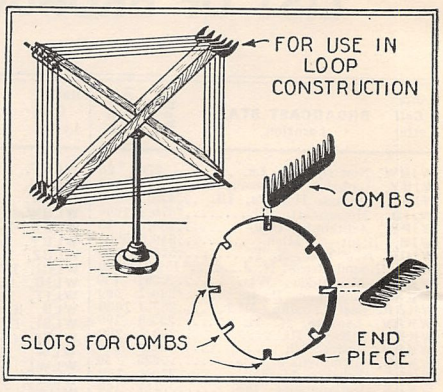
Contributed by Donald F. Holaday.

COIL FORMS FROM COMBS

Coils may come and coils may go, but the home constructor continues to "roll his own." Hence a suggestion how to make a very simple (and at the same time exceedingly efficient) coil form from ordinary combs, obtainable anywhere for a few cents, might be of interest.

Combs, as we know, are usually made of either hard rubber or celluloid, and therefore have excellent dielectric qualities. The teeth come in a variety of sizes, either coarse or fine, and are so spaced that they allow various sizes of wire to be threaded in between them. Thus we grasp the possibility of using this very common toilet article in our endeavor to obtain the perfect coil-form. And, truly, it is close to being perfect according to specifications outlined by the Bureau of Standards, insofar as it permits spaced winding, optimum size wire for frequency intended, minimum of dielectric loss in the coil support, and, of equal importance, mechanical ruggedness.

The figures are self-explanatory. It remains only for the builder to adapt this idea to the particular type of coil desired, whether of the receiving or transmitting type.



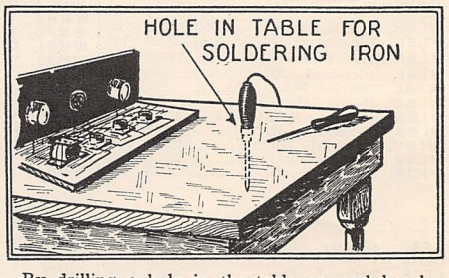
Above are suggested two uses to which rubber combs can be put. There are many other possibilities.

As a final word, the comb for use as a wire spacer and low-loss support is unbeatable for loop construction.

Contributed by Geo. S. Turner.

A PLACE FOR THE IRON

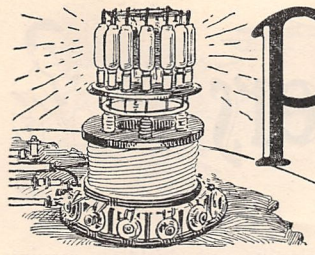
A scheme for holding an electric soldering-iron, when it is not in use, is simply to bore a hole in the work table at a convenient point and to drop the tool through it. The opening should be slightly larger than the shaft of the iron, but not so large that the



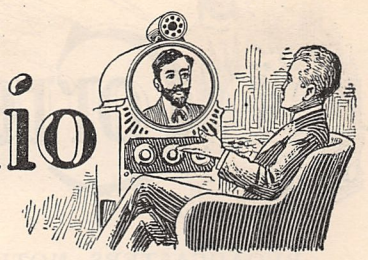
By drilling a hole in the table or work-bench large enough to admit all but the handle of the soldering-iron, a safe place is provided for this device.

wooden handle can slide through. This arrangement makes the inconvenient soldering-iron stand unnecessary. It is safe, and positively prevents accidental burns. You cannot beat it for simplicity.

Contributed by W. W. Somers.

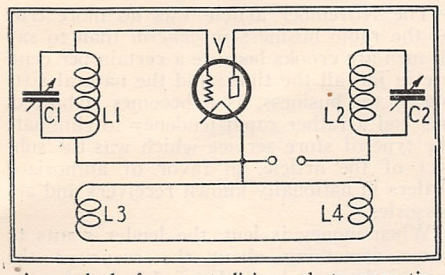


Progress in Radio



NEUTRALIZING ELECTRO-MAGNETIC COUPLING

P. W. Willans and the Igranic Electric Co., Ltd., describe in their British patent No. 260,324 a method of neutralizing magnetic coupling existing between the input and output circuits of a vacuum-tube amplifier. Reference to the accompanying illustration shows a tube V provided with a tuned input circuit L1, C1, and a similar output circuit L2, C2. Normally, the position of the two inductances is such that

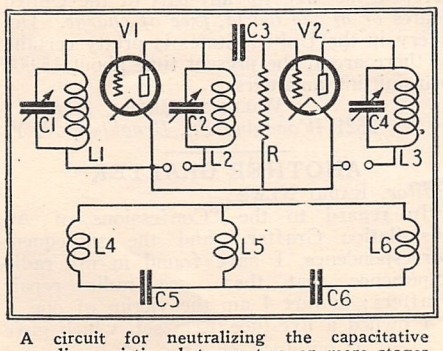


A method for neutralizing electromagnetic coupling by introducing a counter electromotive force in the input circuit. This is accomplished by coils L3 and L4.

there is an appreciable magnetic coupling between the two, sufficient to sustain the generation of oscillations. The effect of this coupling is neutralized by the inclusion of two auxiliary inductances L3 and L4. The inductance L3 is tightly coupled to the inductance L1 and the inductance L4 is similarly coupled to the inductance L2. The number of turns on the auxiliary inductances L3 and L4 is smaller than that of the main inductances L1 and L2. The inductances L3 and L4 are connected to form a closed circuit, and are arranged so that potentials transferred from the output to the input circuit tend to oppose any regenerative effect between the two circuits. A further feature of the invention is the grounding of the two inductances L3 and L4.—*Wireless World.*

NEUTRALIZING CAPACITATIVE COUPLING

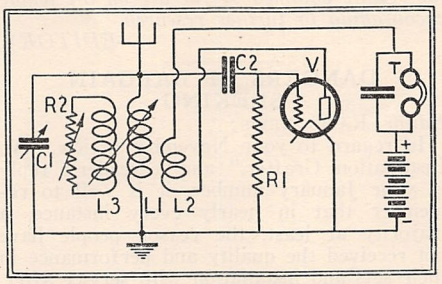
Another British patent, granted to the same patentees, describes a method of neutralizing capacitative coupling, which is brought about through inter-element capacity or stray capacity in the circuits. The arrangement is shown in the accompanying illustration as applied to a two-stage radio-frequency amplifier. Two tubes V1 and V2 are connected through the usual tuned circuits, the input of the system being an inductance L1 tuned by a capacity C1. The plate circuit contains an inductance L2 tuned by a capacity C2. The plate end of the inductance L2 is coupled through a capacity C3 and a grid leak R to the input of the tube V2. An inductance L3 tuned by a condenser C4 is included in the plate circuit of the tube V2, and the three oscillatory circuits are tuned substantially to the same frequency. The stabilizing arrangement comprises three inductances L4, L5 and L6, which are respectively coupled to the inductances L1, L2 and L3. One side of the inductances L4, L5 and L6 is common, while the free ends of L4 and L5 are joined through a capacity C5, and the free ends of L5 and L6 are joined through another capacity C6. The direction of the windings of L4, L5 and L6 is so arranged, with respect to the inductances to which they are coupled, that the potentials induced by them into the main oscillatory circuits tend to oppose those which are introduced by regenerative effects.—*Wireless World.*



A circuit for neutralizing the capacitative coupling existing between two or more stages of radio-frequency amplification.

RESISTANCE-CONTROLLED REGENERATION

N. H. Clough describes in his British patent a method of controlling regeneration by a variable resistance. The illustration shows an ordinary single-tube regenerative circuit in which the input circuit consists of an inductance L1, tuned by a condenser C1, tightly coupled to a tickler coil L2. The usual grid condenser and leak are shown at

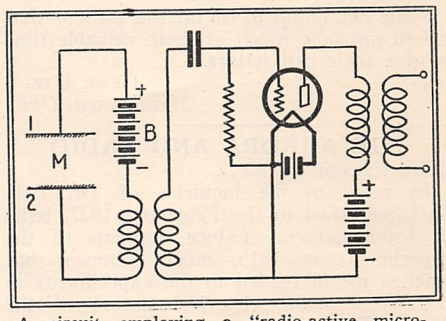


This is an orthodox regenerative circuit, except for the coil L3 and resistance R2. This acts as an absorption circuit and is effective in controlling regeneration.

C2-R1, and the phones at T. The coupling between L1 and L2 is sufficiently great to cause oscillations to be generated, the coupling, of course, being fixed. Variably coupled to the inductance L1 is another inductance L3 shunted by a variable resistance R2. This resistance-controlled circuit consists of one or more turns of resistance wire; or it may be one or more turns of copper wire shunted by a resistance.—*Wireless World.*

A RADIO-ACTIVE MICROPHONE

A novel arrangement for translating sound waves is described in U. S. patent No. 1,605,295, granted James E. Shrader, of Edgewood, Pa., wherein the usual form of microphone is replaced by a space-current path M comprising two elements of radio-active material. This device is connected to a suitable form of amplifying circuit, for building up the weak electrical impulses created by the radio-active microphone. The battery B, connected in series with M, provides the source of poten-



A circuit employing a "radio-active microphone." The sound waves vary the space current between plates 1 and 2.

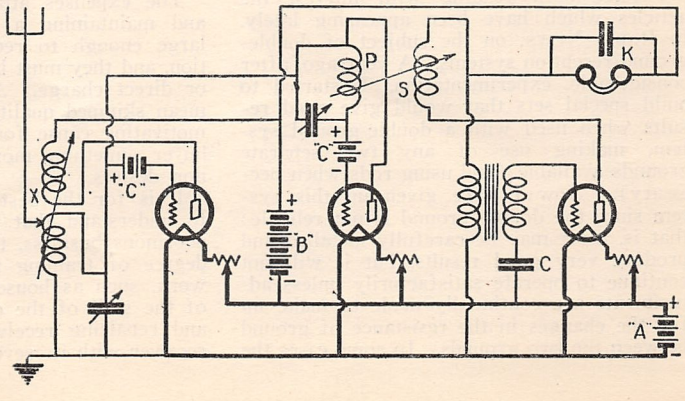
tial, and the amount of current passing between plates 1 and 2 of the microphone is dependent upon the disposition of air pressure. Thus, the current flowing is varied by the impression of sound waves on the radio-active microphone.

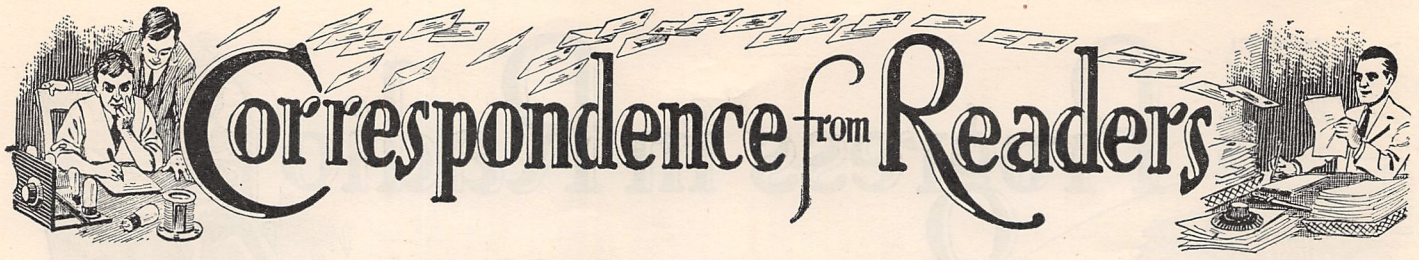
THE "RETROSONIC" CIRCUIT

This circuit is the joint production of John Wilcockson and Harold William Roberts, of Sheffield, who have recently been granted a British patent covering the principles of the circuit. The invention has for its object the provision of a circuit in which great amplification is claimed, the inventors stating that a 3-tube set will give a volume equivalent to that of an ordinary receiver having five or six tubes. In the present invention, three tubes are provided, but the "B" potential is applied directly between the plate and grid of two of the tubes only. The set depends for its operation upon the application of a difference of potential between the plate and grid of the remaining tube by the employment of a radio-frequency coupling, comprising a primary coil located in a loop circuit fed from the aerial and a secondary

(*Continued on page* 1282)

Here is a very unusual circuit to which the name "retrosonic" is given. The first tube employs the usual regenerative coupling. This is coupled to the grid and plate of a second tube which is devoid of the usual "B" voltage. The output of this tube feeds into an A.F. amplifier.





BROADCASTERS, NOTE

Editor, RADIO NEWS:

Why do so many broadcasting stations forget that the reason that they are broadcasting is the indirect advertising that some one gets out of it?

It certainly is aggravating to sit and listen to some announcer who tells all about the composer of a song, who is going to sing it, and a few more things that do not interest the public—and then forgets to tell who is doing the broadcasting.

One night I was listening to a very good program and was anxious to know who was putting it out. At the end of one hour and fifteen minutes I got mad and pushed the switch.

Some one ought to tip off the stations that it will not take much of their valuable time to give their call letters.

GENE UTZ,
Middletown, Ohio.

THE AURORA AND RADIO

Editor, RADIO NEWS:

In reply to the inquiries of Dr. Bela Gati, published in the February, 1927, issue of RADIO NEWS. (Since the date of the experiments in 1919, much comment has reached me in regard to the experiments in reference to the electrical nature of the Aurora Borealis.)

"What was the leakage of the telephone circuit which was measured"?

This value was not determined, and guessing is not scientific.

"Was a D.C. measuring instrument used, or a barretter on audio-frequency current"?

A D.C. voltmeter was used. A polarity-reversing switch was used to reverse the polarity on the voltmeter.

"Was there no direct-current electric-car line in the vicinity"?

There was not an electric-car line within thirty miles of the testing location or any part of the test line. The experiments were conducted at a small town (Perry, Ralls County, Missouri) about 125 miles northwest of St. Louis.

Since the date of the experiments they have been repeated. The voltage values have not always compared, neither has the frequency of oscillation. The facts however, seem to indicate and, to some, prove that the Aurora Borealis develops an alternating voltage lower than any found in commercial use at the present time.

CHESTER L. DAVIS, PH.D.,
251 *Oneida St., Milwaukee, Wisc.*

DOUBLE-GROUND EXPERIMENTS

Editor, RADIO NEWS:

I have been reading with interest the articles which have been appearing lately, in RADIO NEWS, on the subject of double-ground reception systems. A year ago, after considerable experimentation, I started to build special sets that would give good results when used with a double-ground system, making use of any two separate grounds available (and using rods when necessary). Now I have given up this system since the double ground is not reliable; that is, a set may be carefully installed and produce very good results, but it will not continue to operate satisfactorily unless adjustments are continually made to make up for the changes in the resistance of ground between the two grounds. In some cases the conditions will change back to the original; however, entirely satisfactory results seem to be impossible for any length of time. I might mention that I have made installations in various locations and have found the same trouble in each case. The changes are particularly frequent when the ground is sandy, indicating that moisture must have a great deal to do with the fluctuations in the resistance of the system.

As to advantages, static is, of course, reduced a great deal, but interference from near-by sources such as vibrating chargers, X-ray machines, etc., that have any connection to the *ground,* such as through the house-lighting system, is hardly reduced at all. A receiver which has no tendency to oscillate will not give very good results with two grounds. When a set is working properly with the double-ground system it is possible to pick up DX about as well as if an aerial and ground was used.

I have not done much work with real underground aerial systems, but I am convinced that the most practical system is the standard aerial-and-ground method (with its modification, the loop).

NORMAN S. MCINTYRE,
30 *Milford Ave., Newark, N. J.*

(While our correspondent has not been encouraged to continue his work, it is apparent that local conditions were especially unfavorable, due to the lack of moisture in the soil. A plate buried in dry sand is not truly grounded. We believe that, while ground reception is still in the experimental stage, the results obtained so far are on the whole encouraging to further research.

—EDITOR).

DANGERS OF BARGAIN SEEKING

Editor, RADIO NEWS:

In regard to your November article, "An Installation Grafter," and a reader's reply in your January number, it is well to remember that in nearly every instance, a majority at least, the reason people have not received the quality and performance in their sets and installation with service after, that they expected, has been largely due to the public's carelessness in considering the business character of the firms they patronize, and allowing prices to decide the purchase, or in choosing a service man later.

There are firms and individuals in every vicinity whose good character are recognized, but whose service is not patronized because of the fairly common human desire to get a "bargain" in anything. The reliable radio dealer and service man must maintain prices commensurate with equal service and quality in other lines of business.

The expenses attached to installing sets and maintaining a service department are large enough to receive serious consideration, and they must be met by purchase price or direct charge. A "skimpy" profit must mean skimped quality or service, and is the motivating cause for attempting to sell the buyer something more that he neither needs nor desires.

It is for the best interests of the public to understand that "radio" has become an enormous business, that it requires a higher degree of training than ordinary electrical work, such as house wiring, and somewhat of the skill of the clockmaker in adjusting and repairing receiving sets. The modern receiver with its several stages of amplification, special circuits and shielding, requires more knowledge, skill and tools than many "schoolboy builders" or neighborhood tinkers" are able or willing to apply to sets not their own, no matter how successful they have been in building two or three of a certain type for themselves.

The indicated safe way, that some are learning at their own expense, is to buy only from reliable firms, expect to pay a fair price and, if you wish good service later, patronize those who offer this service under a direct charge, just as one would engage an electrician or auto mechanic.

The November article was no more true of the radio business *in general* than to say all men are crooks because a certain per cent. are in jail all the time; and the natural sifting of the business, as it becomes stabilized, has had a rather rapid tendency to eliminate the type of store service which was the subject of the article, in favor of authorized dealers in nationally-known receivers and accessories.

When money is lent, the lender wants to know something about the security; the same judgment should be used before investing in radio. In either case, one is apt to lose money or its equivalent, from a desire to make an apparent profit not necessarily realized in final results.

A. KLINGBEIL,
Ashtabula, Ohio.

(Our correspondent hits the nail on the head in pointing out that the man who tries to get something for less than it is worth is apt to get less than his money's worth. Nevertheless, the radio purchaser who has spent some of his time in studying radio is much better fitted to choose wisely in his purchases than the one who is absolutely ignorant and at the mercy of any glib-tongued talker. Well-informed customers put a premium on honesty in dealers.—EDITOR.)

AMATEUR TELEGRAPH SERVICE

Editor, RADIO NEWS:

I am enclosing an article which appeared recently in one of the New York newspapers (concerning the delivery within one hour of a radio message, sent through an Italian amateur, and delivered to the addressee in Washington, by an American amateur) and think that this should be of interest to the average broadcast listener, as their attitude toward the transmitting amateur is decidedly poisonous.

I just wish to state, that while the time taken to deliver the above-mentioned message is unusually short, an amateur is always willing, in fact, happy to send a radiogram for anybody; any member of the American Radio Relay League will at any time accept a message for any part of the United States *or of the world, free of charge.* Delivery in the United States is pretty certain, as there are at the present time about 15,000 transmitting amateurs.

WILLIAM BRADY, *2ABP,*
2521 *Woodbine St., Brooklyn, N. Y.*

ANOTHER GRAFTER

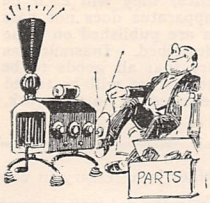
Editor, RADIO NEWS:

In regard to the "Confessions of An Installation Grafter," and the subsequent correspondence, I have found in my radio experience that there *are* radio repair grafters; in fact I am the victim of one.

I owned a five-tube Erla set, which gave

(Continued on page 1295)

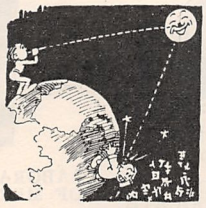
WHAT DOES IT RUN ON?



Newest product of the well-known Detroit manufacturer as told in the November issue of *Engineering Works Review*: "For sale, 5-tube radio receiver with loud speaker, Ford starter and generator, Ford coils and a box of radio parts." We suppose the latter is in case of breakdowns.

Contributed by John S. Hocking.

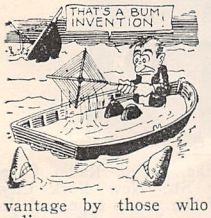
BOYS WILL PLAY



Latest progress in scientific circles, as related in the *Baltimore American*, Jan. 16: "Diagram showing how a powerful BEAN transmitter . . ." This we found to be in connection with signalling the distant planets, and we sure would like to see the fellow that could use a bean shooter that many miles.

Contributed by Wm. H. Hulse.

FOR MARINE NAVIGATION?



We suppose that the article mentioned in the *Seattle Daily Times* of Dec. 29, viz: "For sale, SUPER-BAIL antenna, $7.45," is some sort of a combination radio antenna and bailing equipment for life boats. Yet we have heard a rumor that it can be used to advantage by those who are in trouble with the police.

Contributed by R. G. Lund.

TEN PLATES A DAY KEEP THE DOCTOR AWAY

An announcement in the *Albany Knickerbocker Press* of Jan. 16 of "HEALTH Radiant Condensers," should make the medical profession look to its laurels. Instead of violet-ray machines and other things of like nature, all that the sick have to do is to get the radiations from such a condenser.

Contributed by Chas. L. Spence.

WE BID SIX WITHOUT (LOOKING)

Reaction, due doubtless to the bridge craze, as expressed in the *New Haven Sunday Register* of Jan. 16: "WEAF, New York, broadcast 3834 HONORS in 1926." We sent Mike of the Investigation Dept. to report this prolonged bridge session and he reported that WEAF was 67c to the good. No wonder, with that honor score!

Contributed by H. Naftal.

MAYBE HE GOT ICELAND?

Frigid gesture from the *Chicago Evening Post* of Jan. 13: "I have heard two foreign stations on the COLDER waves, one in Birmingham, and the other in Peru." This is the first time that we had any idea that stations were using anything other than radio waves to broadcast on. These must have been water waves.

Contributed by John Marsh.

GOING TO THE DOGS

Lovers of dogs will please note this advertisement in the *San Francisco Examiner* of Jan. 13: "Radio wanted, 5 tubes or more, for pedigreed dog. Happy Home Kennels." Now there is a kennel that surely does treat its pups right. We would be willing to wager that there are "bigger and better" dogs from that outfit.

Contributed by L. G. Kean.

FIGHTING THE H. C. L.

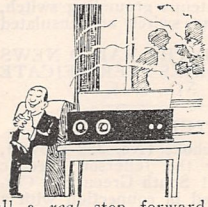
Item of interest in the Jan. 16 issue of the *New York American*: "Many SHIRTS in programs recently at WJZ have resulted from fan mail." No, Oswald, there is no chance for you to get a new shirt of madras or silk. All the shirts these days are of note paper. No, you can't have a pink-and-violet perfumed one, either.

Contributed by E. C. Kuerr.

IF you happen to see any humorous misprints in the press we shall be glad to have you clip them out and send to us. No RADIOTIC will be accepted unless the printed original giving the name of the newspaper or magazine is submitted with date and page on which it appeared. We will pay $1.00 for each RADIOTIC accepted and printed here. A few humorous lines from each correspondent should accompany each RADIOTIC. The most humorous ones will be printed. Address all RADIOTICS to

Editor RADIOTIC DEPARTMENT,
c/o Radio News.

GOOD BYE, FOREVER



In the *New Haven Register* of Jan. 2 we have this gem: "Super Het Oscillator Eliminates HARMONIES." Thank heavens, at last we'll be able to get rid of some of the so-called harmony from our neighbors that meanders around the apartment of an evening. That's what we call a *real* step forward.

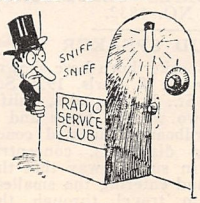
Contributed by Gurdon F. Chatfield.

FRANKNESS ABOVE EVERYTHING

Truth in advertising from a circular of a New York radio jobber: "These dials WILL NOT LAST LONG." This is certainly something only for multimillionaires; for who else could afford to have a gross or so of dials beside the set so that new ones could be placed as soon as the old ones fell apart?

Contributed by Nathan Johnson.

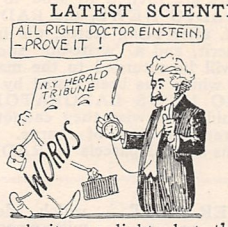
WHAT'S BEEN SLIPPED OVER?



Official secret exposed by the Dec. 31 *Radio Service Bulletin* of the Department of Commerce: "The Kolster decremeter . . . has been RUSED by the radio service of the Department since it was invented." Sounds like some under-cover work; has the radio service opened any night clubs lately?

Contributed by John D. Bowling.

LATEST SCIENTIFIC DISCOVERY



In the *New York Herald-Tribune* of Dec. 31 we have the following announcement relative to transatlantic telephony: "The words will travel at the rate of 186,000 miles an HOUR." We were always under the impression that radio waves had the same velocity as light, but then perhaps Einstein has released something new. Got any dope?

Contributed by B. A. Repelow.

BOOM! BOOM! ALSO BANG!!

"Wonder Device" is the title over a picture in the *Poughkeepsie (N. Y.) Eagle-News* of Jan. 12, of a bank of large vacuum tubes, whch includes the following in the caption: ". . . a circular bank of water-cooled POWDER tubes." Maybe there is gunpowder in the tubes to shoot the waves across the Atlantic. Wonder device is right!

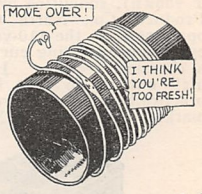
Contributed by Thomas F. Maher.

A WOMAN'S PARADISE

At last a place where women can be happy, as mentioned in the *Greensboro (N. C.) Daily News* of Dec. 30: "The service permits a TWO DAY conversation between London and New York." Just think of that, girls, for two whole days, (48 hours, count 'em!) you can chew the fat undisturbed.

Contributed by H. L. Fleming.

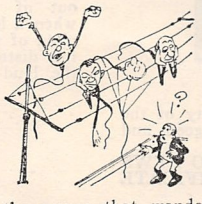
GET OVER!



Educated wire is now available, judging from an announcement in the Jan. 1 issue of the *New York American*: "Such wire is probably the best for inductances as the THINK double covering keeps the turns separated a correct distance." All you have now to do is to tell the turns to keep their proper places and all will be well.

Contributed by Wm. Lemkin.

THE POOR OVERWORKED WAVES



That radio waves are nervous wrecks, is claimed by the *New York American* of Dec. 28, in the following dispatch: "Prof. Pupin . . . asserted that the disturbance called static, the nuisance called JADING in radio has a deep significance." Some of the waves that wander around our antenna sure do sound tired and jaded.

Contributed by J. H. Cornwall.

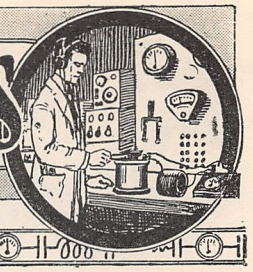
HEY, BILL, GET ME A COIL

In the August issue of RADIO NEWS magazine there appeared this advertisement, which smacks of the supernatural: "A two dollar bill will bring you a filter choke coil." No more wrestling crowds in the radio stores for us. Just hand Bill (of the $2 variety) some change and he will bring you back whatever you are after.

Contributed by Samuel Turek.

RADIO NEWS LABORATORIES

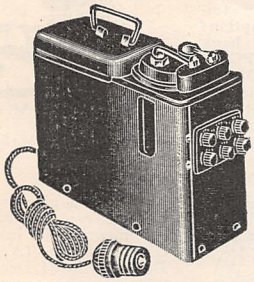
APPROVED RADIO NEWS LABORATORIES 1922



RADIO manufacturers are invited to send to RADIO NEWS LABORATORIES, samples of their products for test. It does not matter whether or not they advertise in RADIO NEWS, the RADIO NEWS LABORATORIES being an independent organization, with the improvement of radio apparatus as its aim. If, after being tested, the instruments submitted prove to be built according to modern radio engineering practice, they will each be awarded a certificate of merit, and a "write-up" such as those given below will appear in this department of RADIO NEWS. If the apparatus does not pass the Laboratory tests, it will be returned to the manufacturer with suggestions for improvements. No "write-ups" sent by manufacturers are published on these pages, and only apparatus which has been tested by the Laboratories and found to be of good mechanical and electrical construction is described. Inasmuch as the service of the RADIO NEWS LABORATORIES is free to all manufacturers whether they are advertisers or not, it is necessary that all goods to be tested be forwarded prepaid, otherwise they cannot be accepted by the Laboratories. Apparatus ready for the market or already on the market will be tested for manufacturers, as heretofore, free of charge. Apparatus in process of development will be tested at a charge of $2.00 per hour required to do the work. Address all communications and all parcels to RADIO NEWS LABORATORIES, 230 Fifth Avenue, New York City.

COMBINATION POWER UNIT

The "A" and "B" combination power unit (Model KX shown) submitted by the Fansteel Products Co., North Chicago, Ill., is a compact assembly in one unit of a "B" battery eliminator and an "A" battery trickle charger. It operates on 50- to 60-cycle house lighting current and uses a chemical rectifier. The unit is controlled by filament switch on the receiver and is automatic in



its operation. The unit will serve any radio receiver using either a 4- or 6-volt storage battery and requiring not more than 30 milliamperes of "B" battery current at 135 volts.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1778.

"B" BATTERY ELIMINATOR

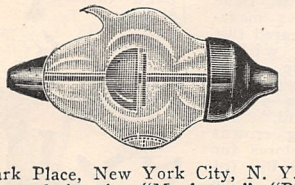
The "B" battery eliminator (Model Y shown), submitted by the Fansteel Products Co., North Chicago, Ill., operates from the 110-volt, 50- or 60-cycle house lighting current and uses a chemical rectifier. It has a very high output, so that it may serve practically any standard set on the market, even when UX-112 or 177

tubes are used. The quality of the supplied current is very good and no hum is heard.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1779.

RECTIFYING TUBE

The neon-gas-filled rectifying tube shown, submitted by The Manhattan Electrical Supply Co., Inc., 17

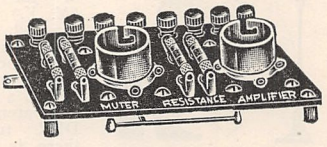


Park Place, New York City, N. Y., is used in the "Manhattan" "B" battery eliminator. It is a half-wave rectifier of special construction, which delivers approximately 40 milliamperes without overloading.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1800.

RESISTANCE-COUPLED AMPLIFIER

The "Muter" two-stage resistance-

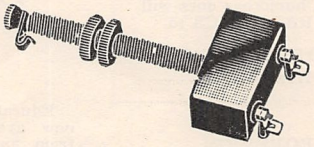


coupled amplifier shown, submitted by the Leslie F. Muter Co., 76th Street and Greenwood Ave., Chicago, Ill., is very neatly built and capable of very fine reproduction of music and speech when used in conjunction with a good detector stage.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1822.

AERIAL LEAD-IN AND SWITCH

The "Right Radio Protector" shown, submitted by the Radio Ray, Inc., Walkerton, Ind., is a combina-

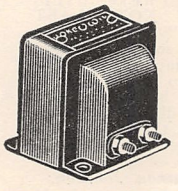


tion of an antenna grounding switch, lead-in cut out switch and insulated lead-in.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1831.

FILTER CHOKE

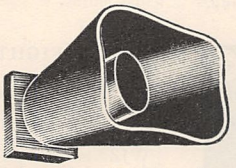
The filter choke (No. 358 shown), submitted by the Jefferson Electric Mfg. Co., 501 South Green St., Chicago, Ill., used in connection with a 2- to 6-microfarad condenser, keeps the relatively heavy direct current out of the loud-speaker windings when a high voltage is applied to the plate of the last tube; thus preventing distortion or even burning out the loud-speaker windings.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1832.

LOUD SPEAKER

The loud speaker horn here shown, submitted by M. J. Carls, 1929 So. Los Angeles St., Los Angeles, Calif., is built of two wooden bases and a series of cardboard truncated cones of increasing diameters, concentrically placed in such a way that the waves of sound entering the smallest cone have to travel through the entire length of the air passage between the cones before they reach the mouth of the last one. The results



obtained during the test, when used with a good loud speaker unit, were very satisfactory.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1834.

TUBE

The "Marathon" tube (MX200-A shown), submitted by the Northern

Mfg. Co., Newark, N. J., is designed to operate best when 45 volts is used on the plate. It is a good detector and can be successfully used in the first stage of a resistance-coupled amplifier.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1847.

LOUD SPEAKER

The "Enchanter" loud speaker shown, submitted by the Jodra Mfg.

Co., Inc., Seattle, Wash., is of the free-edge type. The base and the frame carrying the unit are cast aluminum and artistically designed. The reproduction is very good with regard to quality and volume.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1872.

"B" BATTERY

The "Tab" "B" battery shown, submitted by the Dry Storage Battery Corp., Philadelphia, Pa., is a regular dry-cell battery, but has the interesting feature that it can be recharged several times, thus lengthening the time of its use. 110-volt house-lighting A.C. current or D.C. can be used for charging, provided that the corresponding lamps have been placed in series with the battery. A rectifier is necessary in case A.C. is used.

AWARDED THE RADIO NEWS

LABORATORIES CERTIFICATE OF MERIT NO. 1876.

CONDENSER

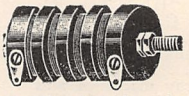
The fixed condenser shown, sub-

mitted by the Venus Radio Corp, 135 Liberty St., New York City, N. Y., is of the paper type and designed to be used as a filter or by-pass condenser. Available in different sizes.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1877.

CHOKE COIL

The "Precision" radio-frequency



choke coil (No. 340 shown), submitted by the Precision Coil Co., 209 Centre St., New York City, N. Y., has its windings placed in four grooves of a hard-rubber form. Its inductance is nearly 0.6-mh. and its distributed capacity is extremely low.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1878.

R.F. TRANSFORMER

The "Precision Duo-Octaform" Coil (No. 320 shown), submitted by the Precision Coil Co., 209 Centre St., New York City, N. Y., is of the binocular type. Each of the two moulded hard-rubber tubes used to form the coil is so shaped that it comes in contact with the winding over a very limited surface. The

coil gives good results, especially when used in receivers having more than one R.F. stage.

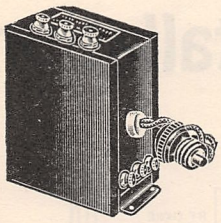
AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1879.

POWER UNITS

The "Thordarson Power Compact" (No. R177 shown), submitted by the Thordarson Electric Mfg. Co., Chicago, Ill., contains in one compound-

filled case the power transformer for the supply of the necessary voltage of the Raytheon "BH" rectifier, two filter chokes, of 80-milliamperes capacity, a 5-volt center-tapped filament supply for one UX-171 power tube, and one buffer condenser. The unit is designed to operate on 110-volt 50- to 60-cycle house lighting current. It is well built, compact, and in connection with the necessary filter condensers operates in the most satisfactory way.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1880.



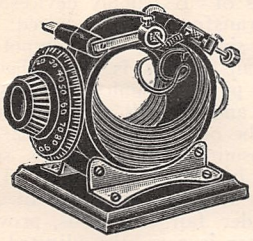
POWER COMPACT

The "Thordarson Power Compact" (No. R210 shown), submitted by the Thordarson Electric Mfg. Co., Chicago, Ill., contains in its compound-filled case, the power transformer for the operation of the UX-216B rectifier tube which supplies 400 volts to the plate of the power tube UX-210, two filter chokes, a 7½-volt center-tapped filament supply for one UX-110 power tube. The unit is of good construction and the results obtained during the test were good.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1881.

CRYSTAL SET

The "Detector" crystal set shown, submitted by the Waterbury Button Co., Waterbury, Conn., consists of a variometer to the frame of which are attached the detecting-crystal holder

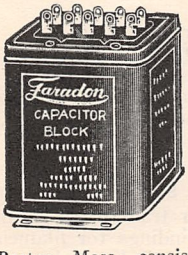


and the necessary binding posts for the antenna and ground and the phones. The set is solid, affords very good reception from local stations, and almost covers the total broadcasting range.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1887.

CONDENSER BLOCK

The "Faradon Capacitor Block" shown, submitted by the Wireless Specialty Apparatus Co., Jamaica



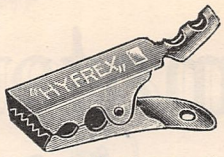
Plain, Boston, Mass., consists of a block of paper condensers having total capacities of 14.2-mf. all in one container and provided with different terminals. This capacitor is especially designed to be used in connection with the most used "B" battery eliminators.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1888.

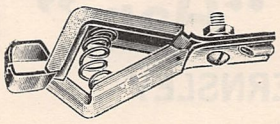
BATTERY CLIPS

The "Hyfrex Testklip" shown, submitted by J. H. Parker-Aeolus Consolidated, Inc., 161 Grand St., New York City, N. Y., is made of nickel-plated brass. It provides a safe contact with the battery terminals.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1889.



The second clip shown, submitted by J. H. Parker-Aeolus Consolidated, Inc., 161 Grand St., New York City, N. Y., is made of heavily lead-plated sheet iron. It is sturdy in construc-

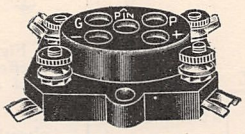


tion and ensures good contact with the terminals of the "A" and "B" batteries. The cables can either be soldered or attached with the screw of the clips.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1890.

SOCKET

The Parker-Aeolus New Type V. T. Socket (No. 8812 shown), submitted by J. H. Parker-Aeolus Consolidated, Inc., 161 Grand St., New



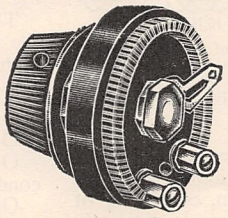
York City, N. Y., is designed to be used in connection with UX-type tubes. Its base is made of molded bakelite and it is provided with phosphor-bronze spring contacts, combined with soldering lugs, ensuring positive contact.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1891.

RHEOSTAT

The "Superior" Rheostat shown, submitted by J. H. Parker-Aeolus Consolidated, Inc., 161 Grand St., New York City, N. Y., is of the one-hole-mounting type. It has a molded bakelite base and knob. The phosphor bronze contact arm ensures in any position a perfect contact with the resistance wire.

AWARDED THE RADIO NEWS

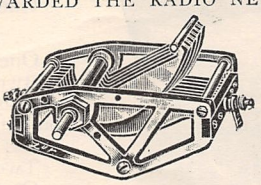


LABORATORIES CERTIFICATE OF MERIT NO. 1892.

CONDENSER

The "Lur Frequency" Condenser shown, submitted by Laissle and Ricker G. m. b. H., Leonhardtstrasse 13, Berlin-Charlottenburg 5 (Germany), is of the straight-line-frequency type. It is very well designed electrically and mechanically.

AWARDED THE RADIO NEWS



LABORATORIES CERTIFICATE OF MERIT NO. 1893.

LIGHTNING ARRESTOR

The "Parkson" lightning arrestor

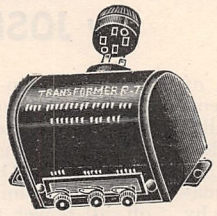
shown, submitted by J. H. Parker-Aeolus Consolidated, Inc., 161 Grand St., New York City, N. Y., is of the non-air-gap type, using a thin paper as separator. The plates forming the gaps are sealed in a porcelain housing. The unit is sturdy and neat.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1895.

TRANSFORMER

The "R7" transformer shown, submitted by the All-American Radio Corp., 4201 Belmont Ave., Chicago, Ill., is designed to supply the necessary voltage to the gas-filled double-wave rectifier tube in a power unit. The transformer operates on 110-volt 60-cycle house-lighting current, and is equipped with a separate plug for connection to the line. It is well constructed and very satisfactory in its operation.

AWARDED THE RADIO NEWS

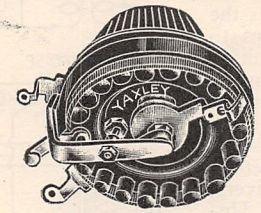


LABORATORIES CERTIFICATE OF MERIT NO. 1897.

POTENTIOMETER

The potentiometer shown, submitted by Yaxley Approved Radio Products, 9 So. Clinton St., Chicago, Ill., is of the one-hole-mounting type. The resistance wire is completely exposed, thus preventing it from overheating. The contact between the movable spring and resistance wire is perfect in any position. It is available in either 200 or 400-ohms.

AWARDED THE RADIO NEWS

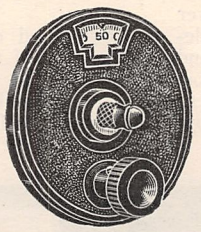


LABORATORIES CERTIFICATE OF MERIT NO. 1900.

DIAL

The vernier dial shown, submitted by the Wireless Radio Corp., Varick Avenue and Harrison Place, Brooklyn, N. Y., is made of molded bakelite and very neat in appearance. The vernier ratio is 10 to 1 and the calibration is from zero to 100. It is easily mounted on any type of set.

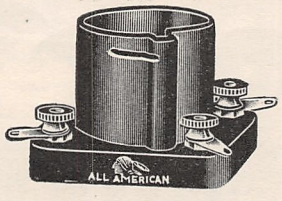
AWARDED THE RADIO NEWS



LABORATORIES CERTIFICATE OF MERIT NO. 1901.

SOCKET

The "All-American" tube socket (Type R-25 shown), submitted by the All-American Radio Corp., 4201 Belmont Ave., Chicago, Ill., is constructed of molded bakelite. The phosphor-bronze springs insure a good

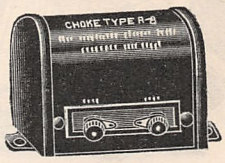


contact with the prongs of the tube. The socket is equipped with knurled nuts and soldering lugs.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1902.

CHOKE COIL

The "All-American" choke coil (Type R-8 shown), submitted by the All-American Radio Corp., 4201 Belmont Ave., Chicago, Ill., is designed



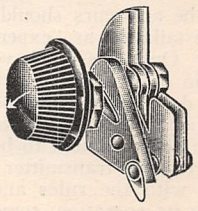
to be used, in connection with corresponding condensers, as the inductance in the filter system of a "B" power unit. It is completely enclosed in a sheet-iron box, and is of very good construction.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1904.

MIDGET CONDENSER

The "W R C" midget condenser shown, submitted by the Wireless Radio Corp., Varick Ave. and Harrison Place, Brooklyn, N. Y., is of the one-hole-mounting type, having plates of aluminum or brass, and available in different capacities.

AWARDED THE RADIO NEWS



LABORATORIES CERTIFICATE OF MERIT NO. 1908.

FIXED CONDENSER

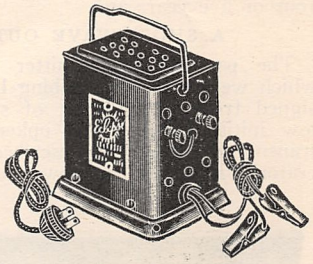
The fixed condenser shown, submitted by the Carter Radio Co., 300 So. Racine Ave., Chicago, Ill., has an interesting feature of its construction, that the value of its capacity can be slightly varied by tightening

a special screw which is provided.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1914.

BATTERY CHARGER

The "Eclipse" battery charger



shown, submitted by the Kodel Radio Corp., 507 East Pearl St., Cincinnati, Ohio, operates on 110-volt 50 to 60-cycle house-lighting current and uses a two-ampere Tungar Rectigon bulb as rectifier. It has two charging rates, 2- and ¾-ampere, and can be very conveniently used as a trickle charger.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1917.

FIXED CONDENSER

The "Carter Hi-Voltage" by-pass condenser shown, submitted by the Carter Radio Co., 300 So. Racine Ave., Chicago, Ill., is of the paper type, designed to be used as a by-

pass condenser and to withstand a relatively high voltage. The condenser is of cylindrical shape and

(*Continued on Page* 1289)

A Simple Inexpensive "Ham" Installation

By JOSEPH BERNSLEY

IT is the writer's belief that a dread of "tremendous expense" and the seeming complication of amateur installations tends to hold back a considerable number of graduates from the B.C.L. ranks who are desirous of becoming amateurs. There is no practical reason why would-be amateurs should consider an amateur installation as "expensive and too technical." One does not have to be a specialist in radio or master radio theory and formulæ, to design and construct a transmitter.

In fact, many successful amateurs know only of these enough to be able to construct a short-wave transmitter and receiver, together with the rules and regulations concerning its operation, some little theory, and how to copy code (which is an essential). These are the most important factors and the only ones that really are required, unless the amateur is really ambitious and aspires to become a specialist. To fulfill this ambition he must seriously experiment and make notes of the results obtained. However, all present amateurs began alike. From some technical book or magazine, they obtained circuit diagrams and constructional details of low-wave transmitters and receivers, which they constructed accordingly. Undoubtedly, they later learned to analyze their circuits, but the point is that they had no better start than anyone has now. In fact, as far as expense is concerned, the advantage is with the present-day beginner. Radio has been simplified, and because of developments in design, production, sales, etc., the cost of radio parts is much less than it was four or five years ago.

A SHORT-WAVE OUTFIT

The particular transmitter and receiver which we are here describing have been designed from a standpoint of simplicity and low initial expense and upkeep. In most transmitters previously described, motor generator, "B" batteries, power units employing large step-up transformers and complicated rectifying systems were suggested as sources of plate supply. An inexpensive "B" power unit whose voltage output is approximately 400 (D.C.) supplies the "B" current to this transmitter. If the switch is turned off, all power to the transmitter is automatically shut off. The circuit employed is of the conventional Hartley type, and is designed primarily for telegraph work. The

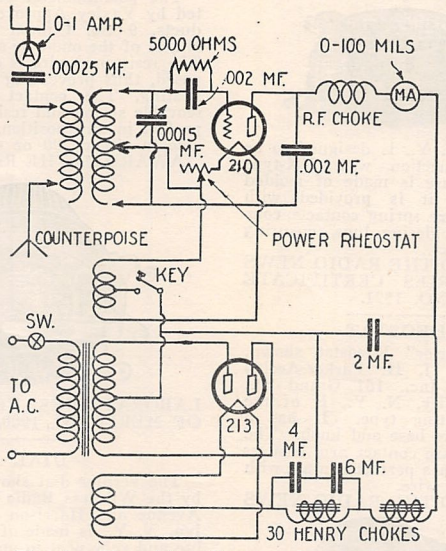


Fig. 2. The wiring diagram of a short-wave transmitter, with a wavelength range of approximately 20 to 100 meters. The plate supply is furnished by any effective "B" power unit.

note emitted depends to a large extent on the purity of the current obtained from the "B" unit. If the filter system, consisting of the choke coil and condensers, is correctly designed, a fairly good quality of D.C.

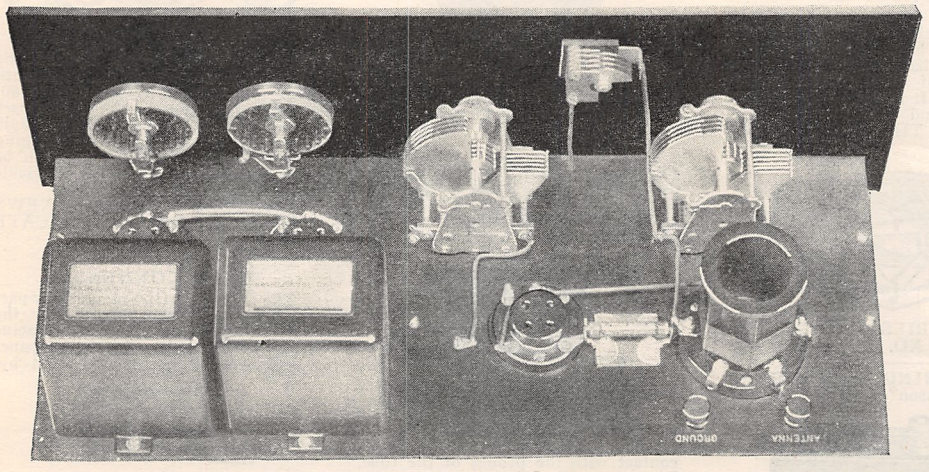


Fig. 3. This view of a short-wave receiver, for which the circuit diagram is Fig. 1, illustrates the simplicity of the entire unit, the position of the various parts, and the symmetrical appearance obtained by care in designing the set.

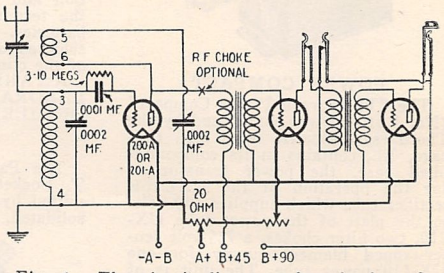


Fig. 1. The circuit diagram of a simple and effective short wave receiver with two stages of audio. A jack is included so that only two tubes need be employed on loud signals.

should be obtained; and a pure continuous-wave note may then be expected.

The filter system employed in the construction of the "B" unit combined with this transmitter (illustrated in Fig. 2) is conventional in design and is used in practically all commercial types of "B" supply devices. A special power transformer is required for this power unit, since the voltage output of ordinary "B" transformers is not sufficient for transmission purposes, unless low-power work is desired and a small receiving tube is employed as the oscillator. A 210 or 310 (7½-watt) transmitting type tube is suggested for use in this transmitter. This power will cover a consistent range of 200 or 300 miles under fair conditions, providing the transmitter is correctly adjusted.

The following are the parts necessary for the construction of the transmitter and the plate and filament voltage supply unit.

TRANSMITTER

One short-wave, low-loss inductance;
One .00025-mf. variable condenser;
One .00015-mf. transmitting type variable condenser, double spaced;
One radiation ammeter, thermocoupled type, preferably 0-1 scale;
Two .002-mf. transmitting type fixed condensers;
One milliammeter, 0-100 scale;
One power rheostat;
One socket;
One 5,000-ohm transmitting grid leak;
One 7½-watt tube;
One R.F. choke;
One transmitting key.

CURRENT SUPPLY UNIT

One special power transformer, consisting of two secondary windings for filament supply, and a secondary winding whose voltage output is in the neighborhood of 525 to 550 volts;
Two 30-henry choke coils;
One 4-mf. by-pass condenser;
One 6-mf. by-pass condenser;
One 2-mf. by-pass condenser;
One snap switch;
One full-wave rectifying tube, 213 or 313 type.

CONSTRUCTIONAL DETAILS

The oscillation transformer may consist of two bakelite tubes, one 4 inches in diam-

(*Continued on page* 1287)

Conducted by Joseph Bernsley

THIS Department is conducted for the benefit of our Radio Experimenters. We shall be glad to answer here questions for the benefit of all, but we can publish only such matter as is of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent. Please make these questions brief.
2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.
3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.
4. Our Editors will be glad to answer any letter, at the rate of 25c. for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

Mr. Bernsley answers radio questions from WRNY every Thursday at 8:15 P. M.

RULES FOR RADIO INSTALLATIONS

(Q. 2206) Mr. D. S. Spiegel, Batavia, N. Y., asks as follows:

Q. 1. Will you please state the requirements (fire insurance companies, or Bureau of Standards, etc.), for the correct installation of an antenna and ground system. I am in the radio retail end of this game and do a lot of set installing. Installations of antennae are quite numerous and I desire to keep up-to-date with the new legal requirements.

A. 1. The following are among the safety rules for radio installations issued by the Bureau of Standards, which are given in full in its new Handbook No. 9, "Safety Rules for Radio Installations."

In erecting antennae and guy wires for your radio sets, see that you do not attach them to telegraph or electric light poles, do not carry your wires over streets or tracks and avoid crossing electrical conductors of all kinds. Antenna supports must be sufficiently rigid and of such size as to withstand any load which may come on them. Attachment to chimneys should be avoided. Metal poles, or masts extending more than ten feet above the supporting building, must be permanently and effectively grounded.

The bureau recommends that locations involving crossings over railroads, supply lines, etc., be avoided; but where no other location is possible, special rules are given for the installation.

In the case of receiving sets, lead-in conductors shall be not less than No. 14 wire (0.064-inch in diameter) if of copper, nor less than No. 17 (0.045-inch) if made of bronze or copper-covered steel. Clearances are given between lead-in wires and other conductors on the building, and it is recommended that lead-in conductors be "securely fastened in a workmanlike manner." The code also requires that the lead-in wire shall enter the building "through a rigid non-combustible, non-absorptive, insulating tube or bushing, or through a drilled window pane."

For receiving sets, grounds must not be made to gas pipes, but should be made to cold-water pipes, if these are connected to a street main. An outlet pipe from a water tank fed by a street main or a well may be used, provided this outlet pipe is adequately bonded to the inlet pipe connected to the street main or well. Where the wire is attached suitable clamps must be used, and the entire surface of the pipe covered by the clamp must be scraped clean.

Rules for the application of protective devices, such as lightning arresters and antenna-grounding switches, are also given. Each lead-in conductor for a receiving set must be provided with a lightning arrester, whether or not an antenna-grounding switch is used. The arrester may be either outside the building or inside if away from combustible materials.

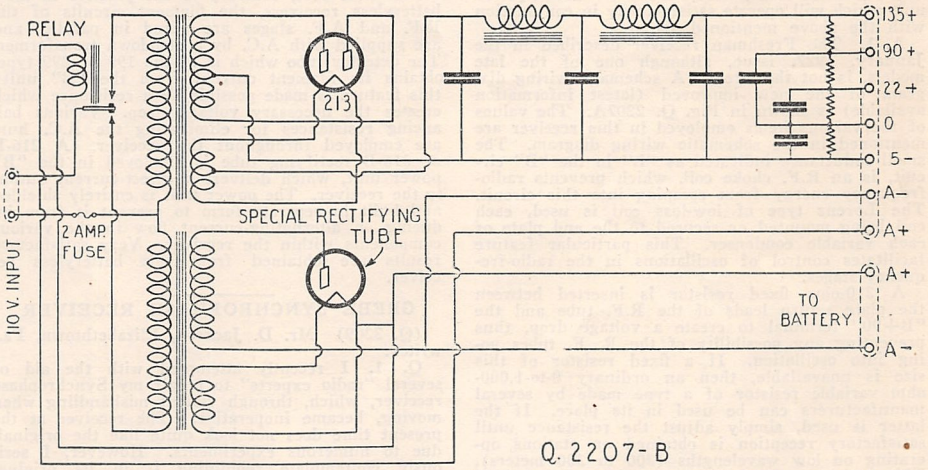
If your set is connected to a power supply-line, the device used and methods of wiring must be in accordance with the rules covering permanent or portable fixtures, devices and appliances, as given in Section 37 of the National Electrical Safety Code. The wiring of storage batteries must also conform to these rules; and such batteries must be placed where there is adequate ventilation.

Copies of this handbook may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

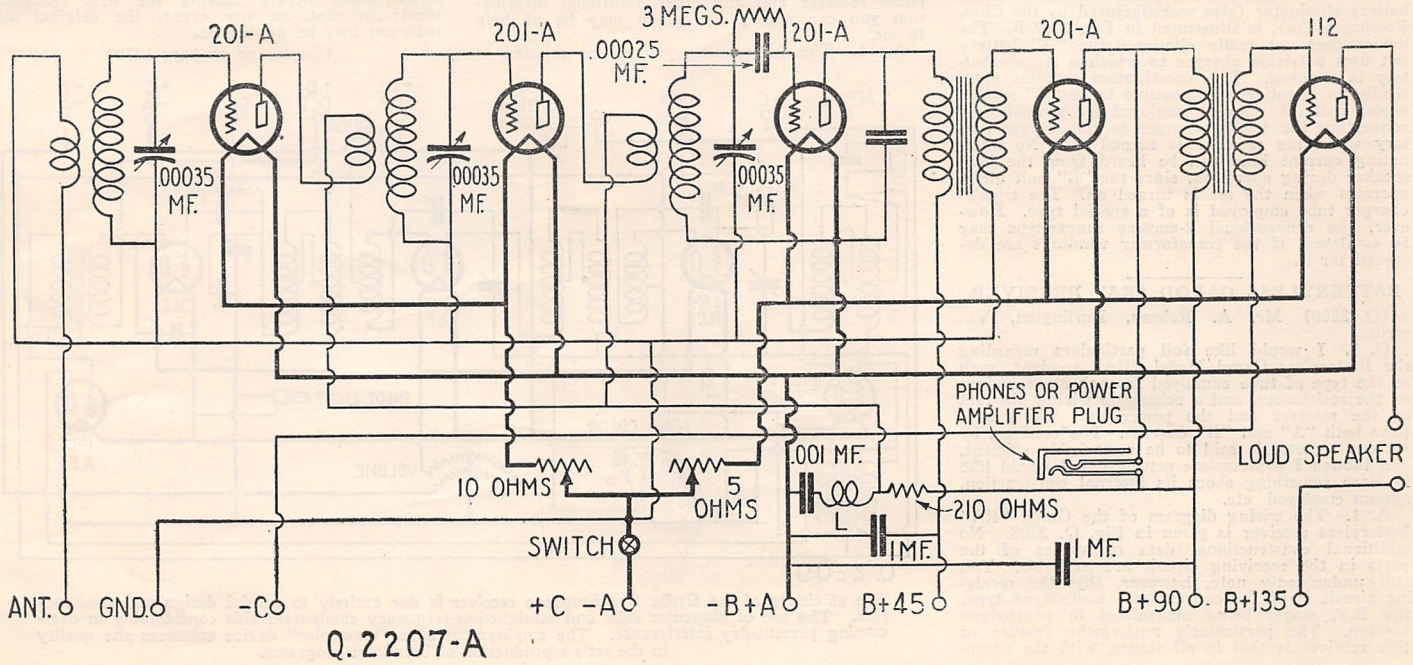
IMPROVED FRESHMAN MASTERPIECE AND "A, B & C" POWER UNIT

(Q. 2207) Mr. S. Lorenz, Waukon, Iowa, writes:

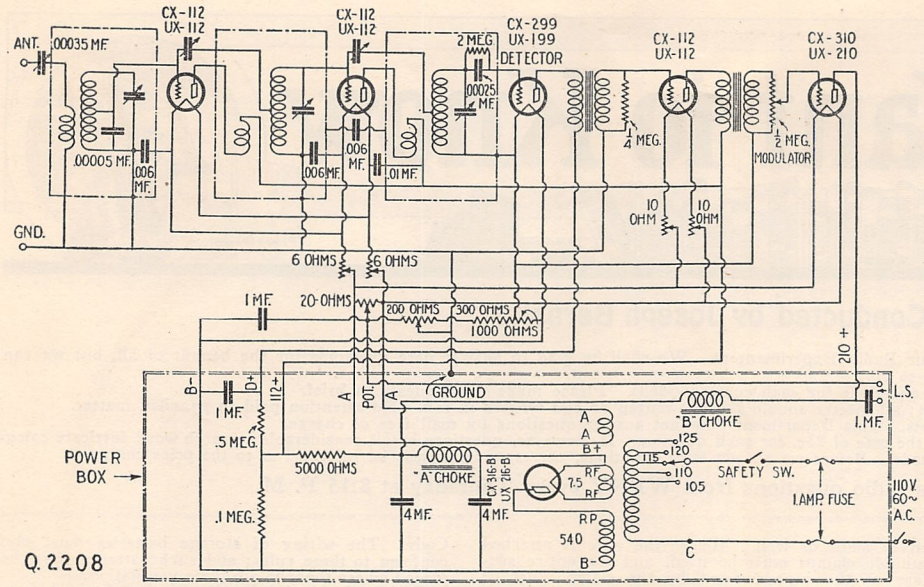
Q. 1. In the "I Want to Know" columns of the January, 1927, issue of RADIO NEWS were given the details of the Freshman Masterpiece receiver.



The wiring diagram employed in the Freshman "A, B and C" power unit. The "A" current delivered is really that of a trickle charger and is connected to a storage battery. This current is sufficient to keep the storage battery in a constantly charged state.



The latest available circuit diagram of the Freshman Masterpiece three-control receiver. A special R.F. choke and a fixed resistance, which do not appear in the earlier types, are employed in this receiver. The receiver is also designed for power-tube operation.



Q. 2208

The Garod E.A. receiver obtains its battery current from the light socket; no trickle charger or storage battery is required. Because of careful design its efficiency is as high as that of any other similar type of receiver. Power tubes are employed in the audio and radio frequency stages and a 199 or 299 type of tube in the detector. The filament current for the detector is obtained from the "B" eliminator.

In the schematic wiring diagram of this set is illustrated a resistance (lettered "R") whose value is not specified. I would like to know the size of this resistance and also have information on the "New Improved Freshman Masterpiece Receiver," providing that the description in the January issue is not of this improved model. I would also like details of an "A", "B" and "C" socket-power unit which will operate satisfactorily in conjunction with the above mentioned set.

A. 1. The Freshman receiver described in the January, 1927, issue, although one of the late models, is not the latest. A schematic wiring diagram of the new improved (latest information available) is shown in Fig. Q. 2207A. The values of the various items employed in this receiver are mentioned in the schematic wiring diagram. The small inductance indicated as "L" in the "B" circuit, is an R.F. choke coil, which prevents radio-frequency energy from escaping into this circuit. The Lorenz type of low-loss coil is used, each coil being mounted or secured to the end plate of each variable condenser. This particular feature facilitates control of oscillations in the radio-frequency stages.

A 210-ohm fixed resistor is inserted between the plate return leads of the R.F. tube and the "B+90" terminal to create a voltage drop, thus preventing any possibility of the R. F. tubes going into oscillation. If a fixed resistor of this size is unavailable, then an ordinary 0-to-1,000-ohm variable resistor of a type made by several manufacturers can be used in its place. If the latter is used, simply adjust the resistance until satisfactory reception is obtained on stations operating on low wavelengths (200 to 300 meters). This resistance is the same as that marked "R" in the diagram printed in our January issue (Fig. Q. 2198 A.)

A circuit diagram of a practical "A, B & C" battery eliminator (also manufactured by the Chas. Freshman Co.), is illustrated in Fig. 2207-B. The device does not really eliminate the "A" battery but uses a trickle charger to which a storage battery is attached. This combination requires practically no attention and amounts to an "A" socket-power unit. A relay is employed for switching or connecting the trickle charger to the storage battery when the receiver is turned off. No alternating current hum can be heard from the loud speaker during operation, since the "B" unit alone operates when the set is turned on. The trickle-charger tube employed is of a special type. However, the conventional 2-ampere tungar-type may be employed, if the transformer windings are designed for it.

BATTERYLESS GAROD "EA" RECEIVER

(Q. 2208) Mr. A. Robson, Burlington, Vt., writes:

Q. 1. I would like full particulars regarding the Batteryless Garod Model "EA" receiver, such as the type of tube employed in each stage, values of the resistances, and a schematic wiring diagram of the receiver and the power unit which supplies both "A" and "B" current. The receiver, by various reports, is said to be remarkably efficient, and though I contemplate getting one I would like to learn something about its internal construction, system employed, etc.

A. 1. The wiring diagram of the Garod "EA" batteryless receiver is given in Fig. Q. 2208. No additional constructional data or values of the parts in the receiving circuit are available. You will undoubtedly note, however, that the receiving circuit is of the conventional neutrodyne type, the R.F. stages being neutralized in neutrodyne fashion. The particularly noteworthy feature of this receiver is that in all stages, with the exception of the detector, storage-battery type tubes are employed. This permits the attainment of maximum efficiency in each stage, and reduces any possibility of A.C. hum, due to the fact that the heavier filaments in these tubes are more adaptable to A.C. operation than the filaments of tubes of the 199 or dry cell variety.

Also note that, contrary to the practice in most batteryless receivers, the filament circuits of the R.F. and A.F. stages are wired in parallel and are supplied with A.C. by a stepdown transformer. The detector tube which is of the 199 or 299 type, obtains its filament current from the "B" unit; this feature is made possible by a resistance which creates the necessary voltage drop. Various balancing resistances for eliminating the A.C. hum are employed throughout the receiver. A 216-B or 316-B rectifying tube is employed in the "B" power unit, which delivers a direct-current output to the receiver. The power unit is entirely shielded and built in separate form to prevent it from inducing an alternating-current flow in the various components within the receiver. Very satisfactory results are obtained from this batteryless receiver.

GREBE SYNCHROPHASE RECEIVER

(Q. 2209) Mr. D. Jackson, Elizabethtown, Pa., writes:

Q. 1. I recently attempted with the aid of several "radio experts" to repair my Synchrophase receiver, which, through violent mishandling when moving, became inoperative. The receiver at the present time does not look quite like the original, due to numerous experiments. However, I seriously contemplate rebuilding it in its original shape, providing you are able to supply me with the necessary information. Most important of all; I need a schematic wiring diagram of the Synchrophase receiver and any other additional information you can supply me which may be of help to me.

A. 1. The information you desire relative to the Synchrophase receiver may be obtained from the manufacturers of this set, who publish an instruction manual in which are contained the wiring diagram of the receiver, hints for adjusting, and correcting troubles, etc.; or else from the distributor of this product in your territory. However, since numerous similar requests have been received by this department, we are publishing a few points of interest relative to the Synchrophase Model MU-1. Information relative to the earlier model will be found in the April, 1925, issue of RADIO NEWS. The schematic wiring diagram of the receiver will be found here in Fig. Q. 2209.

Your receiver will undoubtedly require balancing after it is repaired and the necessary parts replaced. The following is the process for balancing the receiver described in a bulletin issued by A. H. Grebe & Co., which we feel sure will be of considerable help to you when adjusting the receiver.

"Balancing of the receiver must be done while the instrument is in operation. A practical and efficient balance can best be obtained by employing some form of modulated radio-frequency oscillator. This oscillator should have a range of 200 to 550 meters and should be modulated in such a way as to produce a pure tone. The oscillator serves three major purposes:

"1. The balancing of receivers can be perfected when no broadcast stations are available for testing.

"2. The radio-frequency carrier from the oscillator, beating with the carrier set up by the receiver when oscillating, will cause a whistle or beat note which is a sure indication of the unbalanced condition on that wavelength to which the receiver is tuned.

"3. The modulated note forms a final test of perfection of the balance adjustment, since a receiver may be balanced so as to prevent a beat note or heterodyne whistle, but a modulated note may be distorted or 'fuzzy,' requiring a closer adjustment to clear up the modulated tone.

"For these adjustments, the oscillator must be far enough from the receiver to produce only a weak signal, permitting the volume control to be turned up full.

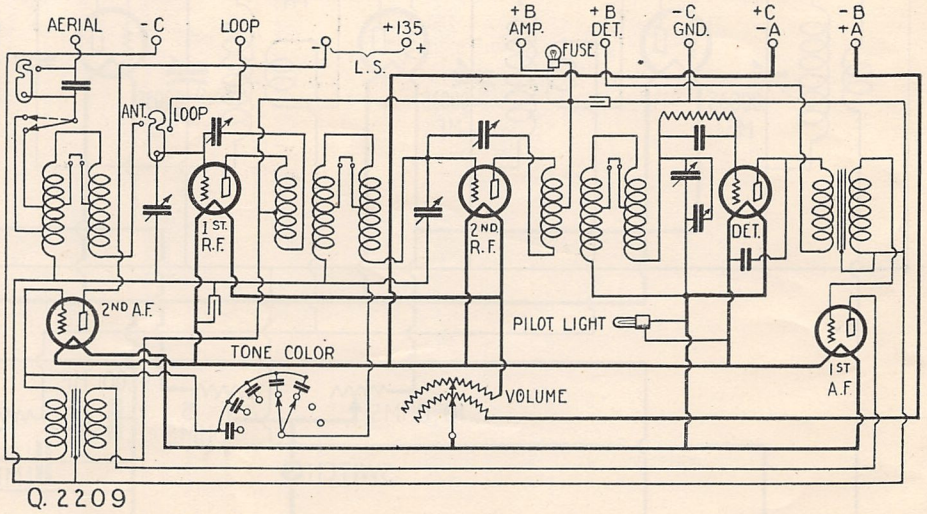
"Where no oscillator is available, a very satisfactory balance can be obtained by employing the signals from a broadcasting station. The method of procedure in this instance is similar to that outlined.

"Since various accessories are often accountable for unbalanced receivers, it is essential that all accessories such as aerial, ground, loud speaker, 'A,' 'B' and 'C' batteries be in perfect condition and properly connected. Perfect vacuum tubes, of the particular type recommended, should be in their proper sockets. The Synchrophase should always be balanced while in its cabinet. The most stable balanced condition will result if the instrument is balanced with at least 135 volts applied to the intermediate-amplifier terminal, where 90 volts is ordinarily connected. The 'C' battery voltage should be left as recommended. On 1926 and 1927 model receivers the wave-changing switch should be in 'high range' position. Loosen dial thumb nuts so that all dials may be operated independently. Set 'tone color' on No. 6 setting. Turn volume control to No. 6 setting. Volume control of 1925 model should be on setting No. 6. Filament rheostat should be turned on full.

"Dials should be set as follows:—No. 1 or left-hand dial in 100 degrees. No. 2 (center or master dial) and No. 3 (right-hand dial) on 40 degrees.

"Before proceeding it would be advisable to note the position of the slots of the adjusting screw heads before making the first readjustment; so that, in any event, the original adjustment may be duplicated.

(*Continued on page 1279*)



Q. 2209

The efficiency of the Grebe Synchrophase receiver is due entirely to careful design and construction. The use of binocular coils and straight-line-frequency condensers aids considerably in overcoming present-day interference. The employment of a "tone-color" device enhances the quality in the set's reproduction of broadcast programs.

"—remarkably good!"

That is the judgment, without exception, of radio experts and enthusiasts who have examined and tested these two fine units

They mean *better reception.* Both have a great deal to do with finer tone-quality. You owe it to your own enjoyment of radio, to know the facts about these fine-quality accessories.

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For purity of tone this handsome product is outstanding among reproducers. It combines ingeniously all advantages of good cone-type reproducers —and the improved quality provided by a special sounding board and sounding chamber. A highly sensitive unit which reproduces voice and instruments naturally and clearly. Perfect uniformity is maintained over the entire musical range, whether amplifiers are turned to full volume, or down to a whisper. Absolute freedom from "inherent pitch" prevents low throaty tones or twangy nasal effects.

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The Giant-Tone Radio Violin

(*Continued from Page* 1236)

tween adjacent turns is low, and the wires lie in a kind of honeycomb arrangement. This method of winding flattens the characteristic curve of the transformer, which improves tone quality. The homemade modulation transformer should be soaked in paraffin for insulation.

The secondary of the transformer is connected to the first tube of a two-tube amplifier, the circuit of which is shown in Fig. 5. A 201A-type tube and a semi-power tube were found sufficient for all purposes. A standard "B" power unit supplied the plate voltage. A concert model loud-speaker unit was used in connection with a 6-foot collapsible horn built of light boards, which could be folded and packed on the running-board of a car. If extreme amplification is desired, the push-pull power amplifier circuit shown in Fig. 6 can be used. Tubes V and V1 are the 201A-type, while V2 and V3 are semi-power tubes. Standard push-pull transformers are employed.

ENORMOUS AMPLIFICATION

The performance of this violin amplifier is phenomenal. The violin alone can be made to supply as much volume as an entire orchestra, yet its characteristic timbre is preserved. In combination with four or five other instruments it makes an orchestra that cannot be equalled for snap and power by orchestras using more than twice as many musicians. The great amplification causes the violin, which often carries the melody, to dominate all other instruments, and to be heard above the shuffle and murmur of the dance hall.

Very probably the same method of amplification could be used on all stringed instruments.

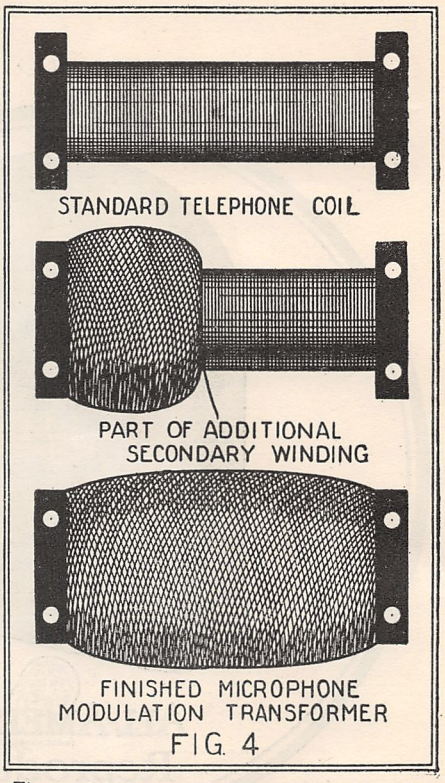

FIG. 4

The modulation transformer, details of which are shown above, can be easily made by the experimenter.

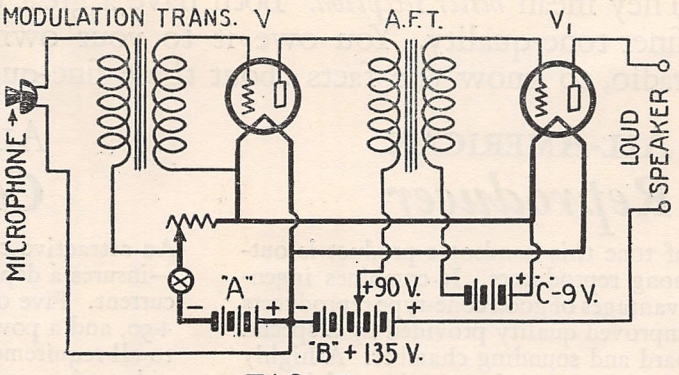

FIG. 5

Fig. 5. At the left is shown the audio-frequency amplifier which is used for amplifying the tones of a violin to "fog-horn" volume. The vacuum tubes, V and V1, are of the 201-A type of amplifiers. As may be seen from the diagram a "C" battery having a value of 9 volts, is used in the grid circuit of the second tube, V1. In the diagram shown below, Fig. 6, there is a stage of push-pull amplification, which insures great volume without distortion.

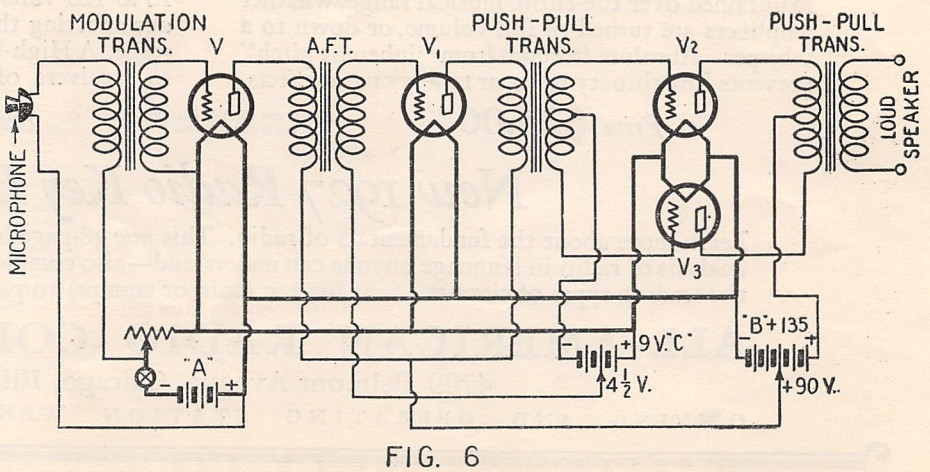

FIG. 6

A four-tube audio-frequency amplifier can be used if extremely great volume is desired, as in our cover illustration. V and V1 are 201-A type tubes and V2 and V3 are semi-power tubes.

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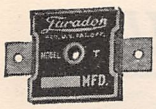

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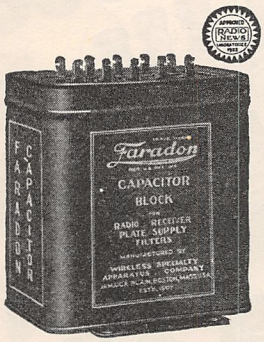

Complete block assemblies for usual eliminator requirements.

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Electrostatic Condensers for all purposes

593

A Complete "A and B" Socket-Power Unit

(*Continued from page* 1228)

is one of the electrolytic type, is mounted upon the extreme rear of the sub-base.

The cable carrying the plug, which would ordinarily connect to the light socket, is cut and spliced with the cable leading from the power compact. The two leads with battery clips on their ends are attached directly to the Abox (A), which is mounted to the right of the power compact. The output posts of the Abox connect to the two binding posts on the panel which are marked "A+" and "A—." The filamentless rectifier tube R and its socket S are mounted between the Abox and the panel. This tube is connected in the "B" power unit only and has nothing to do with the "A" supply.

Between the panel and the power compact we find two small fixed condensers C1 and C2, each of 1.0-mf. capacity, which by-pass the two voltage controls R1 and R2 mounted on the panel. The only other instrument on the panel is the main switch SW, which turns on and off both the "A" and the "B" supply. The four "B" binding posts are mounted along the top of the panel. The two "A" binding posts are mounted on the lower right part of the panel and the three posts for supplying filament current and grid bias for a power amplifier tube are mounted on the lower left part of the panel. The connections for these are shown in the diagram (Fig. 2).

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER ★	
Ch	1	"A" Bat. Charger	2½ Amp.	Bulb or electrolytic type	1	12,13
A	1	Abox			2	
T	1	Power Unit		Power trans. and filter chokes	3	
C	1	Condenser bank	4-4 & 6mf.	14-mf. total capacity	4	14,15,16
C1, C2	2	Fixed Condensers	1-mf.	By-pass	4	14,15,16
R	1	Rectifier tube		Filamentless type	5	
R1,R2	2	Var. Resistors		Voltage regulators	6	7,17,18
SW	1	Switch		10 amp. 115 volt rating	7	
S	1	Socket		For rectifier tube	8	9,19
	9	Binding posts			9	19,20
	1	Panel		8½ X 8½ X 3/16"	10	21,22
	1	Sub-base		9½ X 16 X 1/2" (wood)		
	One Roll	Hookup Wire			11	23

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Fansteel Products Co., Inc.	13 Westinghouse Elec. & Mfg. Co.
2 Abox Company	14 Tobe Deutschmann
3 Thordarson Elec. Mfg. Co.	15 Wireless Specialty App. Co.
4 Sangamo Electric Co.	16 Dubilier Cond. & Radio Co.
5 Raytheon Mfg. Co.	17 Electrad, Inc.
6 Amer. Mech. Labs. (Clarostat)	18 Central Radio Labs.
7 Allen-Bradley Co.	19 General Radio Co.
8 Alden Mfg. Co.	20 X-L Radio Laboratories
9 H. H. Eby Mfg. Co.	21 Amer. Hard Rubber Co. (Radion)
10 Micarta Fabricators	22 Insulation Co. of Amer. (Insuline)
11 Belden Mfg. Co.	23 Acme Wire Co.
12 General Electric Co.	

If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible difference in size from those originally used in laying out and drilling the panel and sub-base.

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★ THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

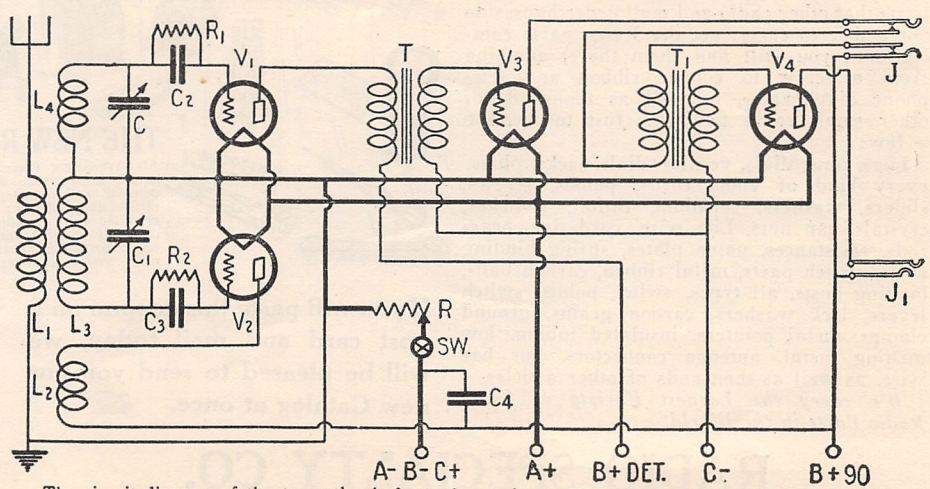
A Transatlantic Radio-telephone Receiver

(*Continued from page* 1225)

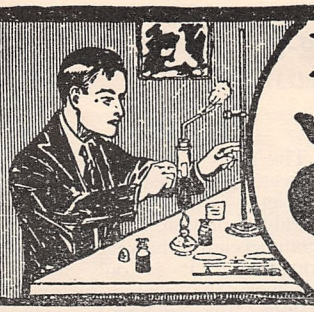
operation on a definite antenna. In getting the receiver to operate properly the fundamental point is to have the oscillator tube oscillating, but *not* the pick-up tube. If you hear a squeal or howl in the phones, both these tubes are oscillating; this may be remedied by slightly turning down the rheostat.

Try varying the coupling between L2 and L3. When the set is operating properly you can tell this by putting a finger on the grid terminal of the oscillator socket, V2, thus producing a thump or click in the phones. If

(*Continued on page* 1288)



The circuit diagram of the transatlantic four-tube receiver. V1, detector; V2, oscillator; V3 and V4 A.F. amplifiers.



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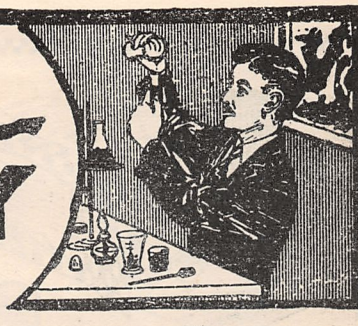

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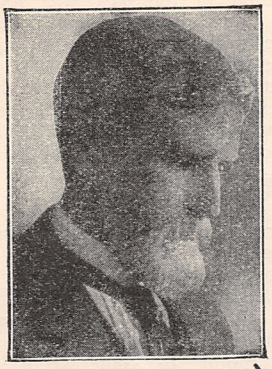

T. O'CONOR SLOANE.
A.B., A.M., LL.D., Ph.D.

Noted Instructor, Lecturer and Author. Formerly Treasurer American Chemical Society and a practical chemist with many well known achievements to his credit. Not only has Dr. Sloane taught chemistry in the class-room but he was for many years engaged in commercial chemical work.

Industrial firms of all kinds pay tempting salaries to get the right men. Salaries of $10,000 to $12,000 a year are not unusual for chemists of exceptional abilities. Chemistry offers those who are ambitious and willing to apply themselves conscientiously the greatest opportunities of any vocation. Why be satisfied with small pay and hard, thankless work—learn the profession of Chemistry and your salary will depend only upon your own efforts and your own abilities.

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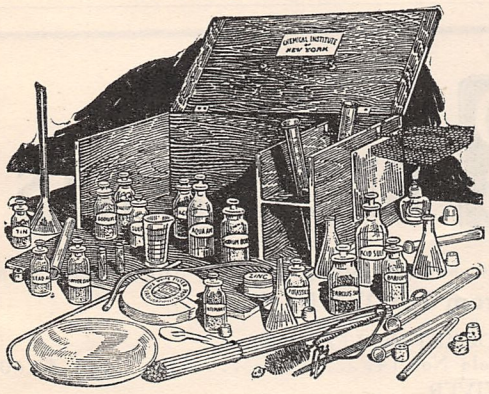

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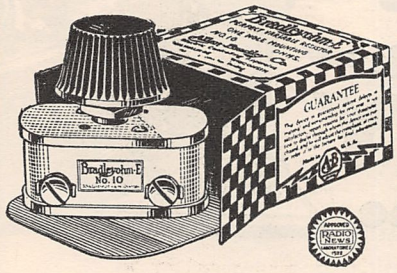

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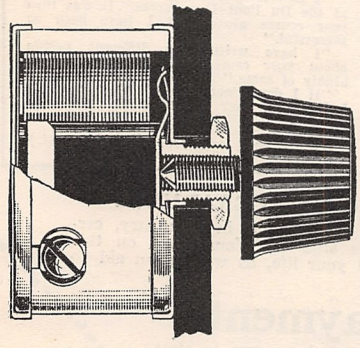

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The Evolution of the Browning-Drake Receiver

(*Continued from page* 1223)

well-nigh perfect amplification obtainable with the modern resistance-coupled amplifiers.

RESISTANCE COUPLING AT ITS BEST

Resistance-coupled amplification, while long recognized for the excellent quality it was capable of delivering, had many drawbacks which have only recently been completely eliminated.

First, there was the difficulty in obtaining suitable resistors which would be silent in operation and remain permanent in value. Unfortunately, the metallized filament resistor could not be used as the input resistor when a special detector tube was employed. Attempts were made to substitute a transformer or an impedance for the input resistor, but such substitutions were always made at a slight sacrifice in quality. For the best of quality the load impedance must be higher than the tube-plate impedance; in the case of one of the new detector tubes, in which the plate impedance is unusually high, the only commercially practical way of obtaining an A.F. input device of sufficiently high impedance at the low frequencies so that it would not "lose" some of the low notes is to use a 100,000-ohm coupling resistor, capable of carrying six milliamperes continuously without noise or depreciation.

To construct a transformer which would have sufficient primary inductance and low enough secondary distributed capacity to meet these requirements, would be a most difficult engineering and economic undertaking. The right kind of resistance, which has long been recognized to be of the wire-wound variety, is the least expensive and most desirable solution. To wind such resistors commercially, however, is quite an undertaking; and it is only after many months of work that a practical process has been developed for winding the many thousands of turns of very fine wire, without breakage, into compact units of such high resistance.

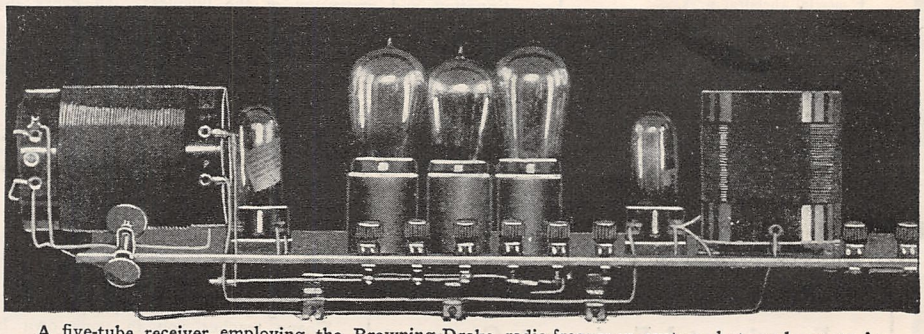
Another objection to resistance-coupled amplification in the past was its lack of volume. This difficulty has been entirely overcome by the use of high-mu tubes, especially developed for the purpose.

Still another difficulty was the high voltage, so essential for the best of results with a resistance-coupled amplifier. The development of the "B" power unit has solved the high-voltage question.

"MOTOR BOATING"

As a result of the use of "B" units with resistance-coupled amplifiers, a new difficulty was encountered in some cases: a tendency for the amplifier to "motor-boat" or oscillate at an audio frequency, causing a noise similar to the "put-put" of a single-cylinder motor to come from the loud speaker. This difficulty has been completely overcome by James Millen in his audio system, by the use of a grid impedance for changing the phase of the grid circuit of the last or power audio

(*Continued on page* 1272)



A five-tube receiver employing the Browning-Drake radio-frequency system, but made up to include design ideas of the present author. This was the first receiver in which the audio-frequency amplifier system was placed between the tuning units.

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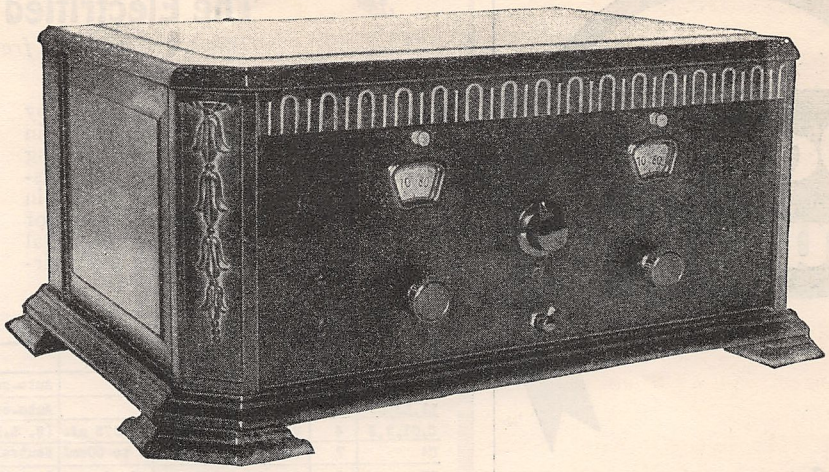

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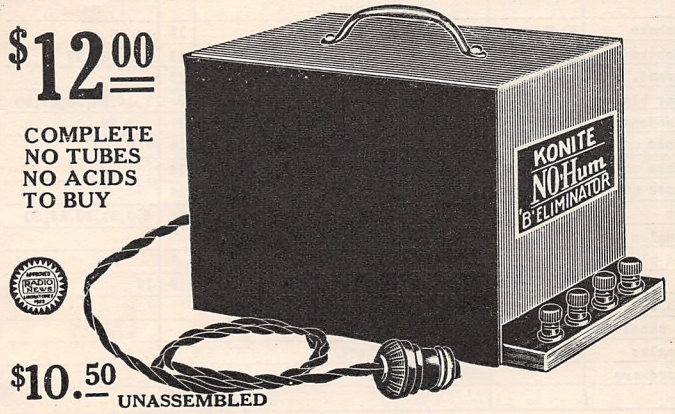

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The operating expense of current used is less than $1.00 per year dependent upon the rate of your local light company.

Works on 110 Volts A.C., 60 or 25 cycles—operates all sets from 1 to 9 tubes.
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ELECTROLYTIC
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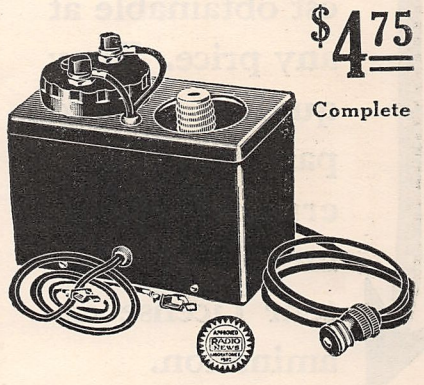

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The RECTI-TRICKLER has been designed after an exhaustive series of tests to provide a self-contained unit at an extremely low cost, a unit that is practical and requires no attention.

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The Electrified Hi-Q Receiver

(*Continued from page* 1235)

side of the base shield as illustrated, by means of machine screws countersunk in the bottom of the baseboard and passing up through the hollow centers of the resistances. Before fastening the resistances in place, it is well to place a 1x6-inch strip of fiber between the resistances and the metal shield base to eliminate possible short circuits. The resistances are then securely tightened down by means of lock washers and nuts.

On the centerline of the shield cover and 2½ inches from the back, drill a ¾-inch hole. In this hole, between two 1½-inch squares of fiber, mount the 50-ohm rheostat, R7, taking care that it is completely insu-

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER ★	
L	1	Ant. coupler		Auto-couple unit	1	
L1,L2,L3	3	R.F. transformer		Auto-couple units	1	
C,C1,2,3	4	Var. condensers	.000375 mf.	(S. L.F) Used with auto-couples	1	
C4	7	Var. condensers	2 to 50mmf	Neutralizing type	1	15,25
C5	7	Fixed condensers	.5 mf.	By-pass	2	3,7
C6	4	Fixed condensers	1. mf.	By-pass	2	16,28
C7	1	Fixed condenser	.001 mf.	By-pass	2	29,30
C8	1	Fixed condenser	.00025 mf.	Grid condenser	2	31,32
R	1	Resistor	2 meg.	Grid leak	3	6,7,17,30
R1	2	Resistors	100,000ohm	Grid voltage supply	3	6,7,17
R2	1	Resistor	50,000ohms	Voltage reducer. Heavy duty	6	7,17,30
T,T1	2	A.F. transformers		High impedance primaries	4	13,15,18
	4	Sockets		UX type with base	5	
	3	Sockets		Ux type without base	5	10,18,24
S	5	Shields		Aluminum. Special	1	
	4	Strips		Aluminum. For foundation	1	
	2	Dials		Vernier	8	4,10,18
AS	1	Ant. switch		Single pole double throw	9	21
SW	1	Fil. switch			9	21
P	1	Pilot light		Including bulb and bracket	9	21,22
R3	1	Potentiometer	400 ohms	Volume control	9	21,23,24,33,30
	4 pr.	Clips		For resistors R1 and R2	2	
	2	Binding posts		For aerial and ground	10	24,25
TJ	1 pr.	Tip jacks		For loud speaker connections	9	21,23
	1	Front panel		7 X 21 X 3/16"		
	1	Audio panel		4½ X 11¾ X 3/16"		
	1	Lug strip		9 X 9/16" X 1/4"		
	2	Mounting clips		For condensers C6. 211/16X3/8X3/16		
	17	Lugs		For terminal strip		
	2	Brass shafts		10 X 1/4" For var. condensers		
	1	Cabinet			11	
V,V1,2,3,4	5	Tubes	3v..06amp.	R.F., det. and first A. F.	12	19,20
V5	1	Tube	5v.1/2amp.	Power amplifier	12	19,20
		Hook-up wire		Flexible stranded	34	35
				POWER PACK		
L4	1	Filter choke	30 H.	For battery eliminator	13	24,26,27
L5	1	Filter choke	30 H.	For audio amplifier output	13	4,24,26,27
L6	1	Power trans.		Special windings	13	
C9	1	Condenser block	14 mf.	For battery eliminator filter	2	7,16,24,28,29,30
C10	1	Fixed condenser	4 mf.	For audio output filter	7	2,3,29,30,31,32
R4	1	Resistance unit	4,000ohms	Voltage reducer	14	
R5	1	Resistance unit	2,100ohms	Voltage reducer	14	
R6	1	Resistance unit	2,800ohms	Voltage reducer	14	
R7	1	Rheostat	50 ohms	Line voltage regulator	9	6,8,21,23,24,30
	4	Brass angles		1" stock		
CP	1	Cord and plug				
V6	1	Tube		Double wave rectifier	12	19
LC	1	Line cable		17 wires bound in cable form.		
	1	Support panel		5½ X 4 X 3/16"		
	2	Brass angles		Straight 1" stock		
		Misc. hardware				

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Hammarlund Mfg. Co.
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3 Electrad, Inc.
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5 Benjamin Elec. Mfg. Co.
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7 Tobe Deutschmann Co.
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12 E. T. Cunningham, Inc.
13 Amer. Trans. Co. (Amortran)
14 Ward Leonard Elec. Co.
15 Bremer-Tully Mfg. Co.
16 Potter Mfg. Co.
17 International Res. Co. (Durham)
18 Silver-Marshall, Inc.
19 Radio Corp. of America
20 C. E. Mfg. Co. (Ceco)
21 Yaxley Mfg. Co.
22 Bruno Radio Corp.
23 Herbert H. Frost, Inc.
24 General Radio Co.
25 X-L Radio Labs.
26 Acme Apparatus Co.
27 National Co.
28 Dubilier Condenser Corp.
29 Wireless Spec. Apparatus Co.
30 Aerovox Wireless Prod. Corp.
31 Polymet Mfg. Co.
32 Leslie F. Muter Co.
33 Central Radio Labs.
34 Belden Mfg. Co.
35 Acme Wire Co.

If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible differences in size from those originally used in laying out and drilling the panel and sub-base.

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★THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

lated from the shield cover. The power pack may now be wired according to the wiring diagram.

CONSTRUCTION OF AUDIO PANEL

Place the audio panel so that the line of 17 small holes is at the front, and the two largest holes, used for mounting the phone tip jacks, TJ, are to the left. Mount the three sockets on the under side of the panel with the plug of the socket passing up through the panel, and the filament posts facing the builder. Soldering lugs are placed under the mounting nuts, beneath the panel, to facilitate making connections.

Mount the two A.F. transformers, T and T1, on the top of the panel with their plate and grid terminals toward the back of the panel. At the left-hand edge mount the two phone tip jacks and in the two holes at the right front, the binding posts for antenna and ground.

Directly back of the line of 17 holes mount the three pairs of grid leak clips, first flattening out the small angle at the base of each clip so that it will lie flat on the panel. Small lugs should be placed under the mounting nuts beneath the panel.

Bolt seventeen 3/8-inch screws in the holes on the front edge of the panel, with the heads of the screws under the panel and the nuts on top, placing a small soldering lug under the head of each screw.

Now turn the panel bottom side up and clamp the four 1.0-mf. by-pass condensers, C6, in place, using long screws and the two bakelite strips for the purpose. These condensers are mounted on top of each other in groups of two, as shown.

The audio panel may now be wired, following the pictorial diagram, and running all wires on the bottom of the panel. Two 6-inch leads are left, as shown, for attaching to the light pilot.

ASSEMBLY

Connect all free leads running from the radio unit to their proper location on the audio unit. Connect the leads to the pilot light, screw a 6-volt bulb in place, and wire in the antenna switch and A and G binding posts.

Fasten the audio panel to the baseboard of the cabinet by two long screws passing up through the baseboard and through the two remaining holes near the middle of the audio panel. Place the proper resistance in the grid-leak clips. Two 0.1 meg. leaks, R1, are inserted in the two front mountings and a 50,000-ohm resistor, R2, in the rear mounting.

Mount the power pack with wood screws passing up through the cabinet baseboard into that of the power pack; first connecting the leads to the switch and 400-ohm potentiometer.

Before connecting the terminal strip from the power pack to the audio panel a small voltmeter and battery should be used to test between the shields and all terminals on the power-pack strip, as well as the corresponding terminals on the audio panel. No reading should be obtained at any point.

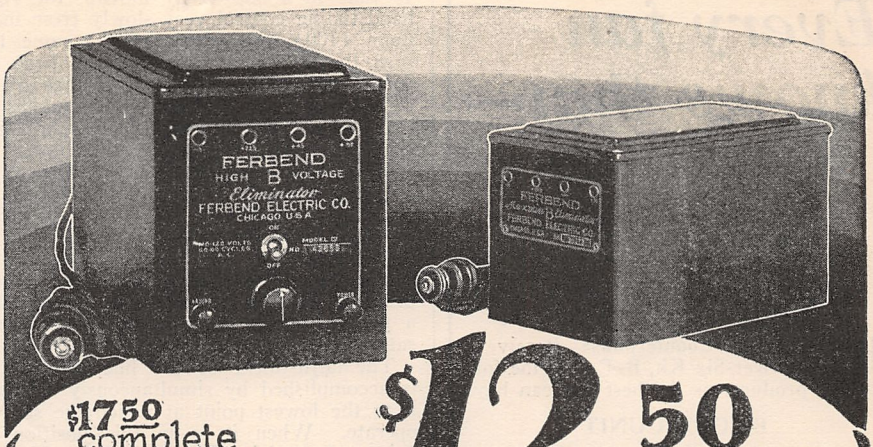
The terminal strip may now be bolted to the audio panel with seventeen nuts, and the set is ready for test.

PUTTING THE SET IN OPERATION

Insert all tubes; connect antenna and ground to their proper terminals on the set, and the loud speaker to phone-tip jacks on the rear of the cabinet.

Turn volume control full on, with the line compensator at about mid-position and connect the line supply plug into the socket (110-volt alternating current only). Turn on the main switch.

Each of the small tubes should glow slightly, indicating that their filaments are in operation, and the rectifier tube and the last audio tube should be brightly lit. An almost inaudible hum should be present in the loud speaker. This indicates that the set is in operating condition, and the pilot



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The Eliminator I purchased from you a year ago has given results that could not be surpassed, regardless of price. I have logged KFI, KGC, KFON, CZE and 6KW.
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Louisville, Ky.
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Outstanding Quality, however, is confirmed only through proof of lasting good performance—so we ask you to read the interesting endorsements reproduced here. They are only a few out of thousands—but actually your best means of verifying the information we give you.

How can we produce a Quality Instrument at a price so spectacular? Because we are pioneer specialists in the manufacture of "B" Eliminators—because every component part is designed, made and assembled under one roof—because our overhead is many times lower.

The Original Ferbend "B" Eliminator operates direct from your Electric Light Socket on 110-120 volt A. C. Lighting Circuit. Delivers up to 100 volts. Price $12.50. The electrolytic method combined with full wave rectification gives results far superior to those obtained by any other method.

The New Ferbend High Voltage Model for extremely large sets and all sets using power tubes. Delivers up to 180 volts. One Control adjusts voltages on all taps. 50-60 Cycle A.C. Price $17.50

Equal to the Best—at a cost less than half! Sooner or later you will purchase a "B" Eliminator. Why pay more?

Money-Back Guarantee

See Your Dealer—or Send Direct

Shipment made direct on receipt of price, or C.O.D. if preferred. Use for 10 days to convince yourself—if unsatisfactory write us within that time and purchase price will be refunded. Send Coupon TODAY.

FERBEND ELECTRIC COMPANY
425 West Superior Street **Chicago, Illinois**

FERBEND "B" ELIMINATOR

Approved and passed by the rigid Laboratory Tests of the two foremost Radio Laboratories in America—Radio News and Popular Radio.

FERBEND ELECTRIC CO.
425 W. Superior St., Chicago, Ill.
[] Send $12.50 model.
[] Send $17.50 model.
[] Send at once. Payment enclosed.
[] Send C. O. D. [] Send Literature.

Name .....

Address .....

City..... State.....

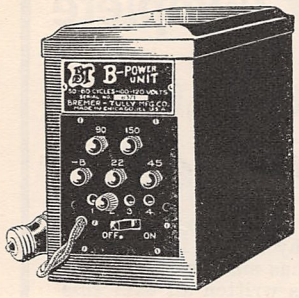
Makers of the original and genuine FERBEND WaveTrap

Every fan knows that—

Every B-T product has been an outstanding success—

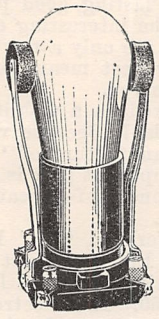
BESIDE the Counterphase Receivers and Power-Six Kit, B-T offer the following products as the best you can buy.

B-POWER UNIT



No variable resistances — no knobs to turn with this Unit. There is no guesswork about voltages. It delivers enough voltage to properly operate the power tubes on multi-tube sets. Price complete with Raytheon Tube $39.50

UX DETECTOR SOCKET



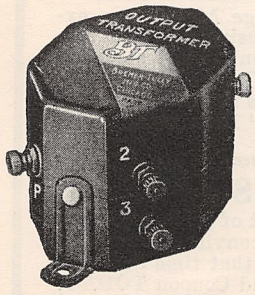
A detector tube socket with double snubbers to kill the howl (vibrating tube elements). The tube is NOT spring suspended. Protection and silent operation made possible by shock absorbing material which absorbs all vibrations.

UX Detector Model $1.00

For general use the UX Absorber Socket protects the tube and permits quieter reception.

It doesn't pay to use inferior sockets when the B-T UXA can be purchased at high-grade dealers for 75c.

OUTPUT TRANSFORMER



A new Bremer-Tully product for use between the last audio stage and the speaker unit. It protects speaker windings from high current passed by type 171 and 210 tubes. With some speakers it improves tone quality. Made with the same care as the "Euphonic" Audio Transformer.

Six terminals offer a selection of ratios.

Price $5.50

CHOKE COIL

It is considered good practice to use choke coils in modern circuits to prevent radio frequency currents from entering audio circuits.

The B-T Choke is housed in a bakelite case and mounts with a single screw.

Price 90c

BETTER TUNING

The B-T booklet describes all B-T parts, sets, kits and B-Power Unit—information on radio you won't find elsewhere—send for your copy today.

BREMER-TULLY MFG. CO.
520 So. Canal St., Chicago, Ill.

light should be fully illuminated. Proceed to tune in a station by moving the right-hand tuning control very slowly from maximum (100) downward; at the same time turn the left-hand tuning control back and forth over approximately the range of the right-hand control. During this tuning operation, the antenna coupler or compensator should be set in the "long" position.

When the station is tuned in, leave the volume control full on, and withdraw the set from the cabinet far enough to enable the line compensator to be adjusted. Turn the volume control toward low position (in a counter-clockwise direction). If no appreciable change in volume is noticed, it is a positive indication that the line compensator is incorrectly set.

The adjustment of the line compensator is accomplished by simultaneously adjusting it to the lowest point at which the set will operate. When it is in this position the volume control is effective in controlling the output to the loud speaker. If during operating it is noticed that the volume control is partly ineffective, it is a positive indication that the line compensator should be set to a lower position.

Letters from Home Set Constructors

(*Continued from page* 1251)

Found that the "B" battery worked just about as good with the "B—" loose. Didn't need any "B" at all, as far as that goes. Had the set hooked on to our regular aerial T, having two 300-foot wires, 70 feet high.

We live in hopes of getting back home some day. Many times I have copied code from Africa, Australia, Japan, Honolulu and the West Coast. So we are not so far from home.

JOHN B. STEWART,
Hq. Co. 31st Infantry, Manila, P. I.

THE "CHRISTMAS TREE" SPEAKER

Editor, RADIO NEWS:

The Loud-Speaking Christmas Tree, instructions for building which are given in your December number, works to perfection with me. I received KDKA, WOC, WAAD, WABC, WCBD, WEAF, and many other leading stations. I have long been a reader of your valuable journal. I have one of the Counterphase hook-ups of Bremer-Tully Co., Chicago, and can praise it highly.

JAMES M. REED,
1401 *Marshall Ave., Mattoon, Ill.*

POLICY THAT MAKES FRIENDS

Editor, RADIO NEWS:

I wrote the Hart & Hegeman Mfg. Co., Hartford, Conn., concerning their wave trap, given the approval of RADIO NEWS in a recent edition, asking if it would help me and stating my troubles. Not only did their radio engineer, Mr. Justin H. Ahrens, answer my questions, but he sent me a wave trap to see if it would be of any help; sending it on memo. only, at no expense to me. Unfortunately, it didn't help matters much, so I returned it.

My reason for writing you is to tell you of their extreme courtesy to me, an absolute stranger, and their taking a chance on my stealing their merchandise is so different from the usual business methods of today—"Money first in case of fire"—that I couldn't resist the impulse to tell you of their unusual handling of my letter of inquiry. Manufacturers like these are a credit to the radio industry.

CARL SAVAGE,
1609 *Montgomery Avenue, Ashland, Ky.*

(We are publishing this letter simply to show how some organizations conduct their business in order to help radio fans. It is refreshing to see letters of this sort, as altogether too many are received here showing the direct opposite of the experience cited above.—EDITOR.)

DOWN IN THE OIL FIELDS

Editor, RADIO NEWS:

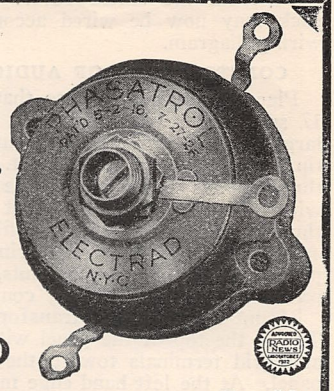
With my home-built two-tube regenerative set (my nearest neighbor is 25 kilometers away) I was cruising the air last night and I tuned in a powerful station with the call letters CUPID! It was a new station; and the above mentioned astonishing call letters must have been a joke of the engineer, because immediately some other person said "Shut up!"

I enjoy very much RADIO NEWS, which is sent to me from Tampico. Mr. Edison should have seen the boys grouped round my set at the Dempsey-Tunney fight. Maybe he would reverse his ideas about radio.

R. W. WEINMANN,
Wildcat Camp, San Isidro, Mexico.

Pat'd. 5-2-'16 7-27-'26

Licensed by Rider Radio Corporation



YOU TOO NEED

"Phasatrols"

A true balancing device for radio frequency amplifiers.

More and more fans throughout the country are using Phasatrol to control the old bugaboo of oscillation.

This instrument, which can be installed in a few minutes' time, has proven of complete satisfaction to old and new radio enthusiasts. Ask your neighbor or better still try one yourself.

At your dealers or write direct. Hook-up circular upon request.

MEMBER RMA

Price - - $2.75

Dept. 27
175 Varick St., New York, N. Y.

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VISIT
LAKEWOOD
NEW JERSEY
and the lovely
LAUREL HOUSE

Midwinter Golf—Winter Sports
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A Perfect Hotel With
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Special Parts
to Build the New
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For sale exclusively by

ROSSITER, TYLER & McDONELL, Inc.
Authorized Hammarlund-Roberts Service Station
136 Liberty Street, New York, N. Y.

Insure your copy reaching you each month. Subscribe to RADIO NEWS—$2.50 a year. Experimenter Publishing Co., 230 Fifth Ave., N. Y. C.

A METAL-PANELED SET

Editor, RADIO NEWS:

Referring to the article by Joseph Riley in your September issue, "A New Idea in Radio Construction," I have a receiving set mounted entirely on aluminum. Mounting it in this way improved the set 100% in every respect.

Up to about a month ago I had never "monkeyed" with radio at all and so at this time know very little about it; but from now on I expect to be one of the worst bugs on the coast.

The set is what is called, I think, a C.R.-5 and from what I can find out from my friends and the radio experts around here it is not much of a C.R.-5 at that.

Before mounting on aluminum I could get only the local stations and not many of those outside of KFI, KHJ, KNX, but the first night after remounting I picked up the following: KFWB, KFSD, KFON, KFWO, KGO, KMTR, KNRC, KPSN, KFSG, KTBI, KFWI, and KFQZ. This is all on loud speaker—large-size Victrola. These are practically all locals, but they were beyond me when the set was mounted on wood.

My limited knowledge will make it impossible for me to give you a very comprehensive description of this set, but I will try. It comprises 130 feet of single-wire antenna; one home-made coil (3-inch tube, about ¼ inch of primary winding and about 1 inch of secondary, both No. 26 wire I think); one variable condenser controlling detection; one variometer controlling volume; one detector tube, two A.F. tubes and two transformers; and two rheostats which seem to have no effect except control the brightness of the tubes. The one for the detector tube is just barely on, while that for the amplification is kept just past center.

I have a fixed condenser, .00025-mf., between the antenna and the set, a resistance between the detector tube and the rheostat and a grid leak on the detector tube and I believe that is everything there is inside the box.

I imagine you will get a kick out of this, for I have to hunt up pictures of the different things in advertisements so I can tell you what they are; *but* I can take this thing apart and put it together in my sleep and it *works.*

The afore-mentioned friends and experts told me I was wasting my time when I started on the aluminum-panel track and that it would not work; but it did and now there is absolutely no body noise at all, and before I had plenty.

Another thing they all marked as N. G. was the mounting of tubes in a horizontal position; and I am glad to know that some one has proved my idea O. K.

D. P. LAMOREAUX,
226 Fourth St., Hermosa Beach, Calif.

ONE-TUBE RECEPTION

Editor, RADIO NEWS:

Just a year ago today I used my first set. This is a Journal one-knob, one-tube set, which I claim to be the world's champion one-tube receiver. It has picked up 51 locals. Its furthest station is NPO, Cavite, Philippine Islands. Its twelve furthest are:

WBAP, Fort Worth; WFAA, Dallas; KPRC, Houston; KWWG, Brownsville; KFXF, Denver; KOA, Denver; 6KW, Tuinicu, Cuba; PWX, Havana, KGO, Oakland; KTCL (now KOMO), Seattle; NPO, Cavite.

HARRY MIRSKY,
637 Cleveland St., Brooklyn, N. Y.

(List enclosed of 203 stations in 32 states, from 167 of which verifications were received. The hook-up of this circuit was described in RADIO NEWS for June, 1926; it is in the highest degree sensitive, but makes a radiating set.)

40 Non-Technical Radio Articles

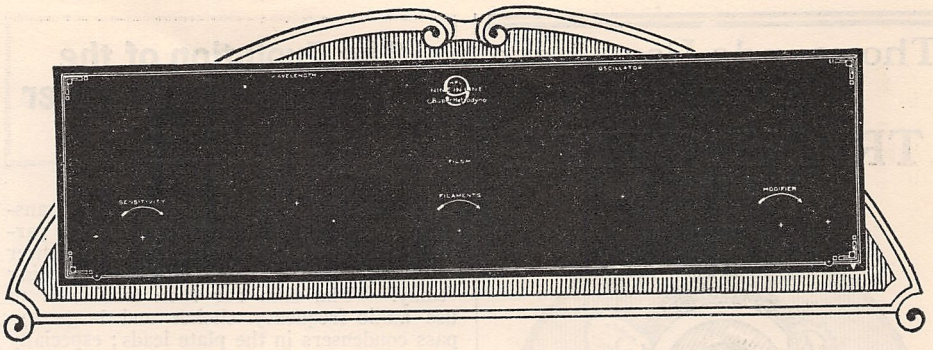
every month for the beginner, the layman and those who like radio from the non-technical side.

SCIENCE & INVENTION, which can be bought at any newsstand, contains the largest an d most interesting section of radio articles of any non-radio magazine in existence.

Plenty of "How To Make It" radio articles and plenty of simplified hook-ups for the layman and experimenter. The radio section of SCIENCE & INVENTION is so good that many RADIO NEWS readers buy it solely for this feature.

Radio Articles Appearing in April Science & Invention

How the Chicago Opera Was Broadcast.
A High-Power "B" Battery Eliminator. By Herbert Hayden
The Aero-Coil Short-Wave Receiver.
"Ricocheting" Radio.
An Inexpensive "B" Eliminator.
Data On the Ultimax Circuit



FORMICA KIT PANELS

FROM one end of the country to the other, home set builders are producing handsome radio sets by the use of Veri-Chromed Formica panels for the leading kits.

These panels include the Karas Equamatic, Bremer Tully Power Six, H. F. L. Nine-In-Line Superheterodyne with sub panel, Victoreen single dial and two dial. There is also an Infradyne 7 x 28" and 7 x 30" Aerodyne, St. James 8 Tube, Bremer Tully Counterphase, Browning Drake National, Madison Moore Superheterodyne, Camfield Duoformer. They are sold by the leading jobbers and dealers.

Special Panels cut to size and Formica Tubing are also available for Amateurs.

SPECIAL SERVICE FOR MANUFACTURERS

Formica is prepared to supply finished insulating parts of high grade workmanship in quantity to radio manufacturers. This service includes threaded tubing, perforated panels and base panels, marked and decorated either by the Veri-Chrome process or by stamping, and punched washers bushings, and parts of all kinds.

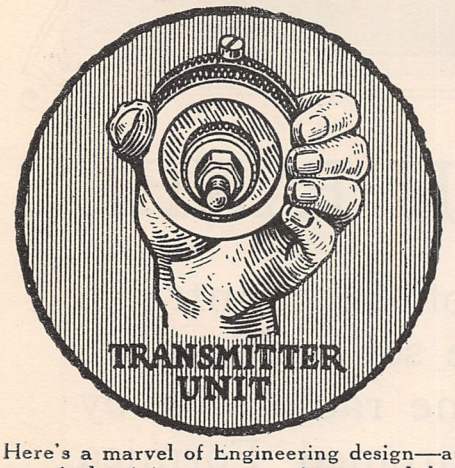
The FORMICA INSULATION COMPANY
4618 SPRING GROVE AVENUE CINCINNATI, OHIO

Hear the FORMICA Orchestra Tuesday 9 to 10 over WLW

FORMICA

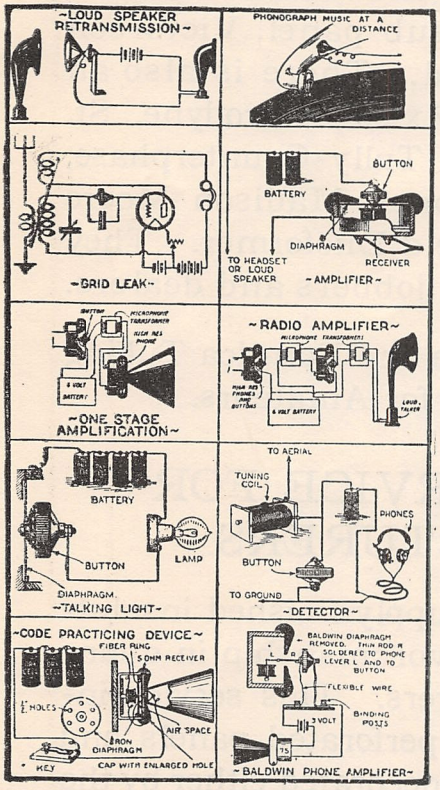
Formica has a Complete Service on Insulating Material for Radio Manufacturers

Thousands Use These Ingenious TRANSMITTER UNITS



Here's a marvel of Engineering design—a practical miniature transmitter, used by thousands of radio fans and experimenters for amplification purposes.
It is a most novel unit, having hundreds of uses. Every amateur should have two or three of these amplifiers in his laboratory.

A FEW USES FOR THESE UNITS



With each unit is mailed an eight-page instruction pamphlet containing suggestions for innumerable uses.
Our supply is limited; avoid disappointment by ordering today. The coupon below is for your special convenience.

SPECIALLY PRICED
While they last— (or Two for $1.75) **95c** per unit

THE PRESS GUILD,
66-R West Broadway, New York, N. Y.
Enclosed find 95c/$1.75 for which send me postpaid one/two amplifier units as advertised.
Name .....
Address .....
City, State .....

The Evolution of the Browning-Drake Receiver

(*Continued from page* 1266)

tube. In the case of high-quality transformer-coupled amplifiers, the use of partially run-down "B" batteries or a power unit may result in the amplifier sounding "tinny." The cure for such trouble is to use audio-frequency chokes and large bypass condensers in the plate leads; especially the detector-tube plate lead, as shown in Fig. 6.

Finally, but perhaps most important, came the placing on the market of really good loud speakers, which has served as an incentive to audio engineers to design companion amplifiers. One form of amplification which has attracted a great deal of attention of late is the dual-impedance amplifier. Such an amplifier is similar to an impedance-coupled amplifier, except for the fact that impedances are used in place of the grid resistors, as well as in the plate circuits.

THE POWER AMPLIFIER

During the past few months, as a result of the work done by James Millen and the writer, there is a growing tendency toward the use of separate audio amplifiers of the lamp-socket-operated variety. Thus, in the case of the Browning-Drake receiver, a two-tube set, without audio amplification, can be used with a separate amplifier unit.

Regardless of the form of coupling used in an audio-frequency amplifier, good quality cannot be secured without the use of a power tube employing the proper plate and grid voltages. There are available for use in a receiver suited to the home two general types of power tubes—the 112 and the 171 types.

The 171 is by far the better tube to use, as it is capable of delivering many times more undistorted power to the loud speaker than the 112. It must, however, be used with a socket-power unit, as it consumes far more "B" current (20 milliamperes at 180 volts, with proper "C" voltage) than is economically obtainable from "B" batteries. Where the use of batteries is essential, then the semi-power 112 tube should be used and the volume of the received signal kept down to prevent distortion due to overloading. The 112 is fairly economical of "B" power.

OUTPUT DEVICES

When using a power tube in an A.F. amplifier it is essential, for the best of quality and as a protection against damage to the loud speaker, to use an output device. There are two general types, the impedance-capacity units, known as tone filters, and the transformers. The tone-filter arrangement is more generally employed in connection with power amplifiers, because it is so designed that it eliminates A.F. current coupling between the plate circuit of the power tube and those of the other tubes. Although the phase of the A.C. in the plate circuit of the last tube, with respect to that in the other plate circuits, is generally of such an angle as not to cause trouble, it is well worth while to eliminate this possible cause of "motorboating" and the choke coil-condenser method does this very effectively.

In a choke-coil condenser output device, the condenser should be of high capacity—3- to 5-mf.—and the choke coil of high inductance, at least 30 henrys. As the direct current cannot pass through a condenser, the direct plate current is forced to flow through the choke coil in order to complete the D.C. circuit. The A.C., or the fluctuating component that actuates the loud-speaker mech-

SPECIFIED AGAIN

There's a reason why

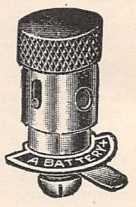
LOFTIN-WHITE Receiver
like all the most popular circuits specify X-L

RESULTS in easier tuning, more distance, volume and clarity—greater stability. Indorsed by leading authorities.

MODEL "N"—A slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Robert's two tube, Browning-Drake, McMurdo Silver's Knockout, etc. Capacity range 1.8 to 20 micro-microfarads. **PRICE $1.00**

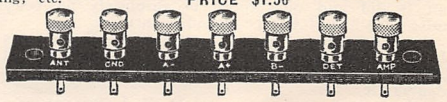
MODEL "G"—with grid clips obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets.

CAPACITY RANGE
Model G-1—.00002 to .0001 MFD
Model G-5—.0001 to .0005 MFD
Model G-10—.0003 to .001 MFD
PRICE $1.50

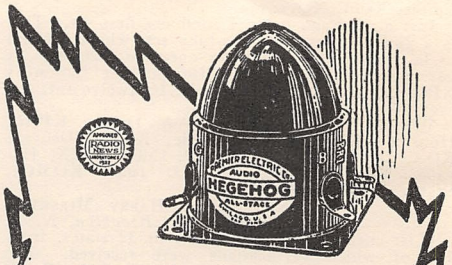


X-L PUSH POST—Push it down with your thumb, insert wire, remove pressure and wire is firmly held, releases instantly. **PRICE 15c**

PUSH POST PANEL—permanently marked in white on black insulating panel. In box including soldering lugs, raising bushings and screws for mounting, etc. **PRICE $1.50**



X-L Radio Laboratories, 2426 LINCOLN AVE., CHICAGO, ILL.



Doc "Hegehog" Cures Transformer Troubles

Guaranteed 99 Years!

When damp, wet, humid weather puts the Gypsy curse on your receiver—chances are the Audio Transformer has gone blooey. **Get rid of it.** Replace with our new "C-L Tite" Hegehog and your troubles are over for good!

Here at last is a weather-proof, hermetically sealed transformer. You can soak it in a bucket of water for **days,** then wipe it off and find its efficiency unimpaired.

The "Hegehog" is little but, oh my!—2¼x2¼x2½ inches Mount it **anywhere,** it's 100% **shielded.** One ratio, all stage, with a 100% flat, distortionless amplification curve. You can't beat it either for volume or quality of tone, and it carries an unconditional replacement guarantee for 99 years.

The price is only $5. All good dealers have the new "C-L Tite" Hegehog or will get it. Or order direct from the makers.

PREMIER ELECTRIC COMPANY
Dept. 399, Grace Street at Ravenswood Ave.
Chicago, Illinois.

NA-ALD

UX POWER TUBES installed in any set without rewiring by, Na-Ald Adapters and Connectoralds. For full information write Alden Manufacturing Co., Dept. K-27, Springfield, Mass.

anism, on the other hand, will readily pass through a large condenser, but not so readily through an inductance.

As the purpose of the capacity-inductance output device is to separate the plate current of the last or power audio amplifier into its two components, and to make each of these components go through separate circuits, it is essential, to obtain the best of quality, that the separation be complete. Thus, to prevent loss of the low notes, the inductance of the choke coil must be sufficiently high to prevent any appreciable amount of low-frequency audio current from passing through the choke coil rather than through the condenser and speaker. However, the D.C. resistance should be kept low to prevent a drop in the effective plate voltage on the power tube. A very great drop in this voltage is found when an ordinary loud speaker is connected directly in the plate circuit of this tube and is the direct cause of much distortion in ordinary receivers. The instructions accompanying the 112-type tube, for instance, call for a negative bias of 9 volts when 135 volts is used on the plate. Placing the speaker in this circuit cuts the 135 volts down very considerably and to maintain the proper bias the 9-volt tap should be reduced to about 7.5. The choke-condenser system rectifies this trouble.

MECHANICAL IMPROVEMENTS

While such improvements, from an electrical point of view, are being made to the Browning-Drake system, it is only natural to expect improvements and refinements of equal importance along a mechanical line. Perhaps one of the most noticeable has been made in dials; we now have the variable-ratio vernier dial with an illuminated scale and place for recording the station call letters. The variable vernier permits of a rapid motion when tuning in local stations or in going from a station at one extreme of the broadcast wave band to one located at the other. The illumination is of the indirect variety, now in such vogue for automobile instrument boards. Then, too, the condensers have been mechanically changed so that they are more compact, and have lower electrical losses, lower minimum capacity, smoother action and a variety of plate shapes for different requirements. Perhaps the new plate shape, which gives results just halfway between straight-line-frequency and straight-line-wavelength, will be the most popular.

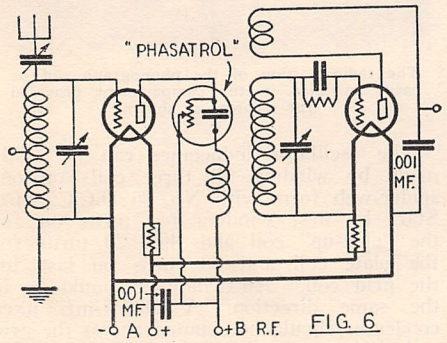
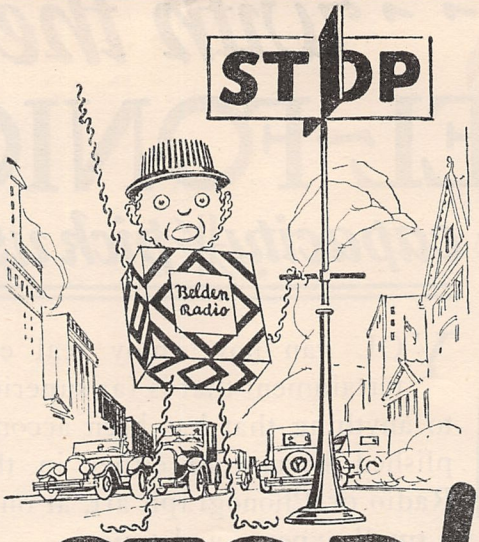


FIG. 6

The introduction of the "phasatrol" compensating device in the Browning-Drake circuit permits the use of a 6-volt R.F. tube.

THE NEW B-D RECEIVER

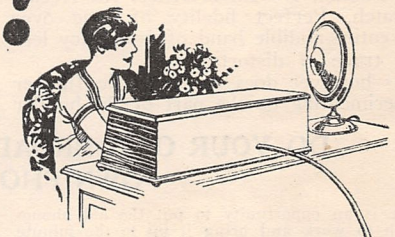
With all of these new developments in mind, the writer, in collaboration with several well-known specialists in their own individual fields, has designed a new Browning-Drake receiver in which a special R.F. amplifier tube with "Phasatrol" neutralization and a high-quality A.F. amplifier unit have been incorporated, as well as such mechanical refinements as illuminated dials. This receiver will be described in the May issue of RADIO NEWS. A later article will tell how to powerize this new receiver.



Don't Burn Out Tubes Discharge Batteries Incur Fire Hazard

STOP!

Use a
Belden Fused Radio Battery Cord

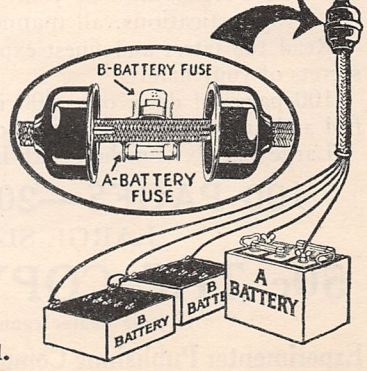


MAKE a neat job of wiring the batteries to your set by using this handy battery cord and get the tremendous advantage of fuse protection for your batteries and tubes. Fuses in the A and B battery circuits of the Belden Fused Radio Battery Cord prevent burned out tubes and damage to batteries due to short circuits.

Crossed wires can neither start fires, ruin batteries, nor burn out tubes if you use a Belden Fused Radio Battery Cord. Fuses are not interchangeable with each other or automobile fuses. You cannot get fuses of incorrect rating in the clips.

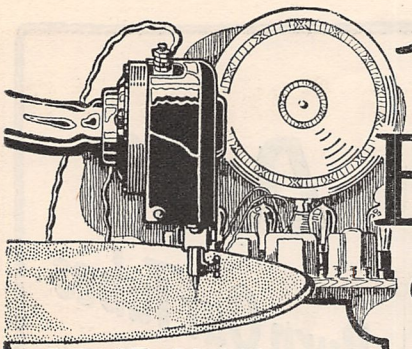
Every set needs the protection provided by the Belden Fused Radio Battery Cord. Don't risk operating your set without it. It is cheap insurance.

Fuses are enclosed in a neat bakelite two-piece cover.



Ask your dealer to show you a Belden Fused Radio Battery Cord and explain the protection it provides. Get one today!

Belden Manufacturing Co.
2314A So. Western Ave., Chicago, Ill.



. . with the EL-FONIC capacity pick up

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With every El-Fonic Pick-Up a complete set of blueprints and instructions of how to build the Jewell Audio Amplifier.

YOU can now enjoy real entertainment that is far superior to anything that has been accomplished heretofore either in the Radio or Phonograph art, at only a small expense and time.

TO THE EXPERIMENTER

The amplifier has been specially designed and balanced to insure: No Static, No Fading, No Interference, No Needle Scratch, Perfect fidelity of tone over the entire audible band of frequency less any trace of distortion.
This however does not preclude further experimenting on the part of the builder as this new means of modulation opens up a field in electrical acoustics that is new and adaptable to hundreds of uses and circuits. Both the Pick-Up and Amplifier are the invention of Mr. Fred A. Jewell and covered in detail by him in his article appearing in this issue.

DO YOUR OWN BROADCASTING FROM YOUR OWN PHONOGRAPH

Here is an opportunity to put the old phonograph to work and bring it up to the minute in reproducing your favorite records comparable to the higher priced electric phonographs and at the same time continue your experiments in a new field of Radio application.

Forwarded by Parcel Post Prepaid upon receipt of remittance.

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Audio Frequency Transformers
Amplify faithfully every note in the scale—each transformer tested ten times—**your** set needs one for perfect reproduction. Model A.F. 3—$12.00. Model A.F. 4—$8.50.
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HEAR *the wonderful New Acme Speaker at your dealer's.*

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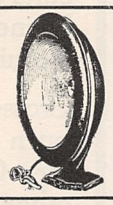

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Combining the Phonograph and Radio

(*Continued from page* 1239)

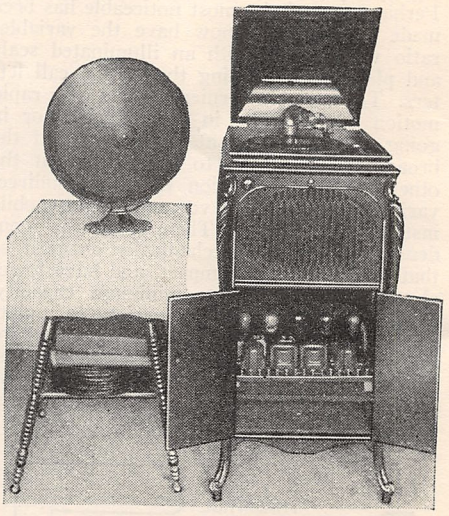
distortion is not encountered in this circuit, it is then passed on to the loud speaker in a form as pure as it was when it was cut on the record.

Many types of audio amplifiers will readily suggest themselves to those familiar with the art. One that gives good results was described in the June, 1926, issue of RADIO NEWS and is known as the "Jewell Audio Amplifier." This amplifier has been carefully balanced for this type of a "pick-up," and will give excellent results when used with a good cone loud speaker.

CONSTRUCTING THE AMPLIFIER

Fig. 1 also shows the amplifier coupled to the oscillating detector circuit. Any one who has a phonograph may secure one of these "pick-ups" and build this amplifier.

The coils L4 are grid chokes and may be any audio transformers with the primaries and secondaries connected in *series aiding*. L3 are plate chokes of about 200 henrys; their windings should be heavy enough to pass the plate current. The audio transformers should be about 4 to 1 ratio, and rather high-pitched to prevent over-accentuating of bass notes. The R.F. transformer should be of the untuned type, which covers a band of frequencies anywhere between 200 and 500 meters.



The radio portion of the phonograph can be easily installed in the compartment provided for records, as shown.

The oscillator inductance can be easily made by winding all three coils on one spider-web form with No. 26 D.C.C. wire. Start by first winding ten turns on for the "pick-up" coil and then 20 turns for the plate coil and 28 turns on last for the grid coil. All windings should be in the same direction. A .00025-mf. fixed condenser should be shunted across the grid coil. The connections are as follows: The lead nearest to the center of the spider-web coil connects to the plate C1 of the "pick-up," the other, or next lead of the "pick-up coil," connects to the plate side of RFT. The next lead after the "pick-up coil" connects to the 45-volt "B.+." The other lead of the plate coil connects to the plate of the oscillator tube V. The next lead after this one connects to the grid of the oscillator tube and the last or outside lead connects to the negative of the "A" battery.

For the best results, the best parts should be used in the construction of this amplifier as well as the best accessories, such as tubes, batteries and loud speaker. To ex-

perienced constructors many modifications and variations will suggest themselves. However, the circuit given in this article is a sure-fire one and when the directions are followed out, the results obtained will be more than worthy of the small expense and time involved.

$300 Prize Set Building Contest

(*Continued from page* 1229)

With the improved instruments which we have now, much better results should be obtained. Then, too, we now have shielding, which we did not have in former days, and this improvement should do wonders, too, in helping us to keep out stray currents where they are not wanted. All in all, the future for the Superregenerator seems rosy.

WHAT IS WANTED IN THIS PRIZE CONTEST

RADIO NEWS desires the best portable Superregenerative set that can be constructed. There is an urgent demand for such sets for automobiles, motor boats, policemen, traveling men, and others. The loop used with the Superregenerator may be quite small, and can easily be attached right to the portable case. The competition, therefore, eliminates separate loops, it being necessary that the loop should be included right in the portable. The loop should be fixed into place and should not be a folding loop. Loop tuning would, therefore, be done by turning the case in to the correct compass direction.

The complete set in no case must exceed the following dimensions: length 12 inches, depth 7 inches, height 8 inches. Into this space all the instruments, loop, batteries, tubes, loud speaker, or 'phones, must be placed. The above dimensions are not rigid, so long as the cubic content, namely 672 cubic inches, is not exceeded. In other words, the width or the length may be varied, so long as the cubic-inch content of 672 is not exceeded.

As an added feature, for the protection of inventors, RADIO NEWS will do the following:

PATENT RIGHTS GUARDED

It should be known to would-be inventors, that the publication of any circuit in RADIO NEWS is the best patent reference that can be had. If the circuit and description is published in RADIO NEWS, the inventor has two years thereafter in which to file a patent application, and thus he gets the best possible protection.

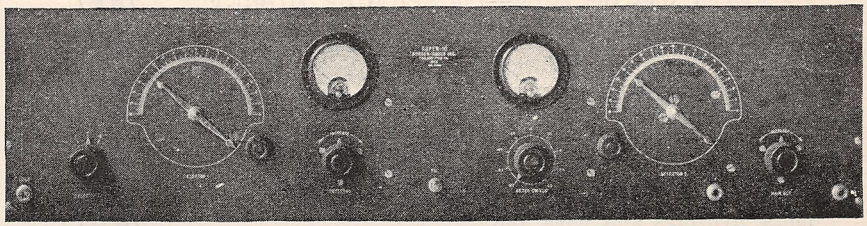
Furthermore, as an added incentive to the inventor, always providing the circuit is patentable, RADIO NEWS hereby agrees to take out a patent in the inventor's name, paying the entire patent fees; and the patent, if issued by the U. S. Patent Office, will belong, of course, to the inventor in whose name it will be taken out.

Also remember that this contest is *for constructors only;* no patents, no mere ideas, or descriptions of sets can be entered in this contest. The actual set must be shipped to RADIO NEWS, and, after it has been tested in RADIO NEWS LABORATORIES, it will be returned to the constructor. Right here we wish to issue a word of warning. In former competitions many sets became automatically disqualified because they were shipped with such poor packing that when the case was opened it contained nothing but a lot of junk. Remember that cases are dropped frequently during transit and that the set must be packed well, as follows:

PACKING DIRECTIONS

First, be sure that all instruments are fastened down to boards with at least ½-inch

Norden-Hauck Super-10
AROUND THE WORLD WITH THE U. S. NAVY



Panel size, 36"x9"x¼" Super 10-tube Standard Admiralty Model Weight: 55 lbs.

A SUPER-10 has been installed on board the "U. S. S. Wright," now sailing for Asiatic waters with the U. S. Aircraft squadrans. This receiver will also be used for entertaining civilian representatives at various ports of call.

A New and Advanced Model
Highest Class Receiver in the World

THE NORDEN-HAUCK SUPER-10 is an entirely new and advanced design of Receiver, representing what we believe to be the finest expression of Modern Radio Research Engineering. It is the product of years of experience devoted exclusively to the attainment of an ideal Broadcast Receiver—regardless of cost.

Results obtained in every respect will upset all your previous ideas of good radio reception. The unusually large number of unsolicited testimonials constantly being received from users—concerns and individuals of international repute—indicates the absolute superiority of the NORDEN-HAUCK SUPER-10.

You, too, may enjoy the advantages of this wonderful receiver at a surprisingly moderate cost. Here are only a few of the host of features that place the NORDEN-HAUCK SUPER-10 far in advance of competition.

—10 tubes employed to give perfect reproduction with unlimited range and volume power.

—Super selectivity on all wave lengths.

—Built to Navy Standards.

—Wide wave length range without change of coils, 200-550 meters full.
(Adaptable 35 meters to 3600 meters if desired.)

—Use Loop or Antenna.

—Simple to operate, having only two major tuning controls.

—No Harmonics. Signals are received only at one Point.

—Special Power Audio Amplifier, operating any loudspeaker and eliminates necessity of external amplifier.

—Can be operated directly from house current with socket power devices.

—Thoroughly shielded at all necessary points.

Complete Price List for Socket Power Operation

1	Norden-Hauck SUPER-10, completely constructed and laboratory tested	$307.00
*1	Heavy-Duty 200 V. "B" Eliminator and Tube, 50/60 cycle A/C 110 V.	42.50
1	Automatic "A" Power Supply, complete	29.50
10	Tested Tubes, including Power Tube	22.50
1	Western Electric Cone Speaker, 540AW or Farrand Sr., and Plug,	32.60
1	Set Antenna Equipment, complete	5.00
2	"C" Batteries	2.00
	TOTAL COST OF ALL ITEMS—NOTHING ELSE REQUIRED...	$441.10

* 25/30 cycle A/C current, $47.50.

PROMPT EXPRESS SHIPMENTS NOW BEING MADE.

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☐ Please send me without cost or obligation on my part, attractive illustrated literature describing the new Norden-Hauck Super-10.

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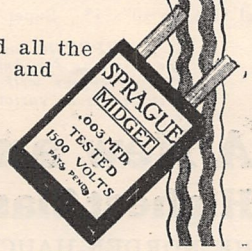
Since the first electric car in 1888—a Sprague invention—many electrical engineering advancements have been given industry—by Sprague.

No wonder that the latest—the SPRAGUE MIDGET fixed condenser—is attracting such widespread set-builder interest.

For the MIDGETS are factory tested at 1500 volts—have higher uniform breakdowns—constant capacities—insulated casings—quarter the weight—half the size; in short, they are midgets with electrical hearts of giants. Their new flexible lugs—presoldered—short-cut assembling expenses; saving screws, nuts, bolts, drillings and wire, too.

Just your address will bring you samples and all the reasons why Sprague Midgets will improve and economize in *your* set construction.



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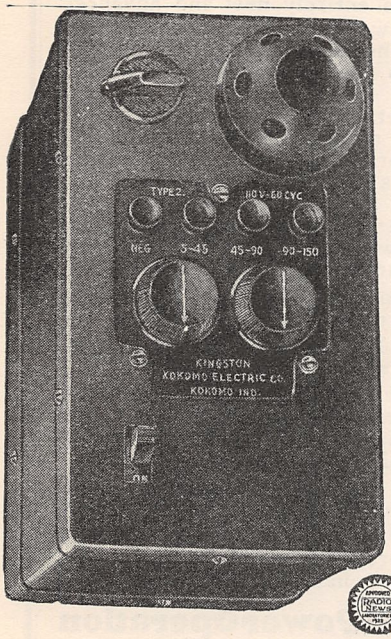

For Good Reception!

Guaranteed to remove the battery nuisance and deliver clearer tone and increased volume. Provides three different voltages at the same time. Each tap adjustable over a wide range, making possible any desired voltage from 5 to 150, absolutely harmonizing "B" current supply to your set. Raytheon tube used as rectifier. No noise or vibration. Contains no acid or solution and will not get out of order. Operating cost negligible.

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We furnish blue prints, finishing material and instructions. Buy the works, dial, weights and pendulum from us at surprisingly low prices. You make a fine profit building artistic clocks for your friends.

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wood screws, or 6/32 or 8/32 screws bolted in place with nuts. All connecting wires should be soldered, preferably. It is not necessary to ship tubes, as the Laboratories will use their own. After you are sure that the set is ship-shape for traveling, wrap it up in heavy paper and then get a wooden case, *never a cardboard one,* and put a layer of excelsior on the bottom, then pack excelsior all around and on top of set, and pack it in fairly solid, but with enough space to give a little cushioning. The set itself should never touch the wood of the packing case. The entire set should float on excelsior. This is the only safe method.

CONDITIONS AND RULES OF THE SUPER-REGENERATOR SET COMPETITION

1. A portable Superregenerative set is desired, with as many novel features as possible. Any number of instruments, of any type, may be used. The set should preferably be free from hand capacity and should not be tricky to operate, if this can be accomplished.
2. Portable sets only are admissible to this competition. The size of the set must not be larger than 12x7x8 inches, or its equivalent, 672 cubic inches. These dimensions should include not only the entire set, loud speaker, or phones, but also batteries, tubes, loop, etc. Loop may be attached to cover of case, or otherwise, but must be built in.
3. No one shall be eligible for a prize unless the set has been actually built and constructed.
4. All sets in this competition are to be sent to RADIO NEWS; transportation charges for the set being paid both ways by RADIO NEWS.
5. Parts used in the competing sets may be standard parts, obtainable on the market, or they may be home-made. It is, however, preferable to use standard parts.
6. Contestants must submit also a complete wiring diagram drawn in ink on white paper, 8½x11 inches, in which the diagram of the parts must be distinctly marked and the correct values given, as, for instance, number of turns, wire sizes, diameter of coil, capacity of condensers, etc. On the reverse side of the wiring diagram a description of the set is to be typed or written in ink, in not more than 500 words. The judges are particularly interested in learning how this set performs, how it is tuned, what DX it brings in, ease of tuning, etc. If DX stations have been received, give log of such stations.
7. Bind all papers firmly together so they can not be separated, and note that on *every sheet of paper and every photograph,* entrant's name and address must be clearly printed. No penciled matter can be considered. Use either typewriter, or pen and ink.
8. Rolled manuscripts are excluded from this contest. Use photomailer wherever possible (obtainable at all stationery stores).
9. Name and address must be clearly shown on the set itself, for identification purposes, by using Dennison tag and attaching it to some part of the set by means of string or cord. Name and address must also appear on the outside of shipping case.
10. This contest closes May 20, 1927, at noon, by which time all entries must have been received by RADIO NEWS. Announcement of the prize winners will be made in the September, 1927, issue of RADIO NEWS, on the publication of which the prizes will be awarded.
11. From this contest are excluded the employees of the Experimenter Publishing Co. and their families.
12. The prizes of this contest will be awarded to those persons who submit the most novel, interesting and satisfactory Superregenerators, in the opinion of the judges. The matter of workmanship does not primarily enter into the contest, except insofar as it may assist the judges in deciding upon the relative merits of different sets. Prizes, therefore, will be awarded not so much on the appearance of the sets as upon the actual performance of the sets themselves. The judges of this contest will be a board comprised of the editors of RADIO NEWS, the editors of SCIENCE AND INVENTION and the editors of RADIO INTERNACIONAL. Their findings will be final.
13. Address all entries to Editor, Superregenerator Contest, care of RADIO NEWS, 230 Fifth Avenue, New York City.

PREVIOUS ARTICLES

To those who wish to study up on Superregenerators, the following articles will be of interest, having appeared in back numbers of RADIO NEWS:

The Superregenerative Receiver, July 1923.

The Autoplex Circuit, November 1923.

Superregeneration and the Future, January 1926.

Superregenerative Circuits (Standard

Hook-ups), Sept. '24, Nov. '25, Dec. '25, Jan. '26.

Superregenerative Circuits (I Want to Know), Oct. '22, Apr. and Oct. '23, March '25 and Nov. '26.

Radio News of the Month

(*Continued from page* 1217)

GIANT AIRPLANE SPEAKER

A MILE above the earth, a singer entertained a Times Square crowd in New York a few days ago. The loud speaker, which carried his voice downwards, operates on the 1000-watt output of a group of power tubes. This largest of speakers is illustrated in April SCIENCE AND INVENTION.

STATE RADIO LICENSING

THE problem of intrastate radio regulation has been raised by the introduction of a bill in the New York legislature to provide for licensing broadcast stations under the authority of the state public service commission, and including a censorship. The legal phases of concurrent state and national regulation would afford much work for the lawyers, should such a measure become law.

TRAIN RADIO SERVICE

ONE shilling (Austrian) per hour is the charge for listening-in on the Austrian express trains, to and from Vienna, under a new arrangement made by the Austrian Railways Company. The sets used are of sufficient power to bring in the principal European stations.—*C. L. Vydra.*

RADIO FOR THE BLIND

AUSTRIA is the first country to take up systematically the collection of radio equipment and funds to furnish all its sightless unfortunates with the consolations of radio. There have been distributed 910 sets, almost all of the crystal type. Germany, following the example, has collected already 421 sets and over 300,000 marks for the purpose—*Horst Kottas, Vienna.*

NEW WARSAW STATION

A HIGH-POWER, long-wave (900-1300-meter) station has been established in Warsaw by the "Polskie Radjo" broadcast company. It will have a 1-kw. output, and is erected on the Szczesliwice fort outside the city (don't ask us to pronounce it)! The height of the masts is 275 feet.—*Ted Erlich.*

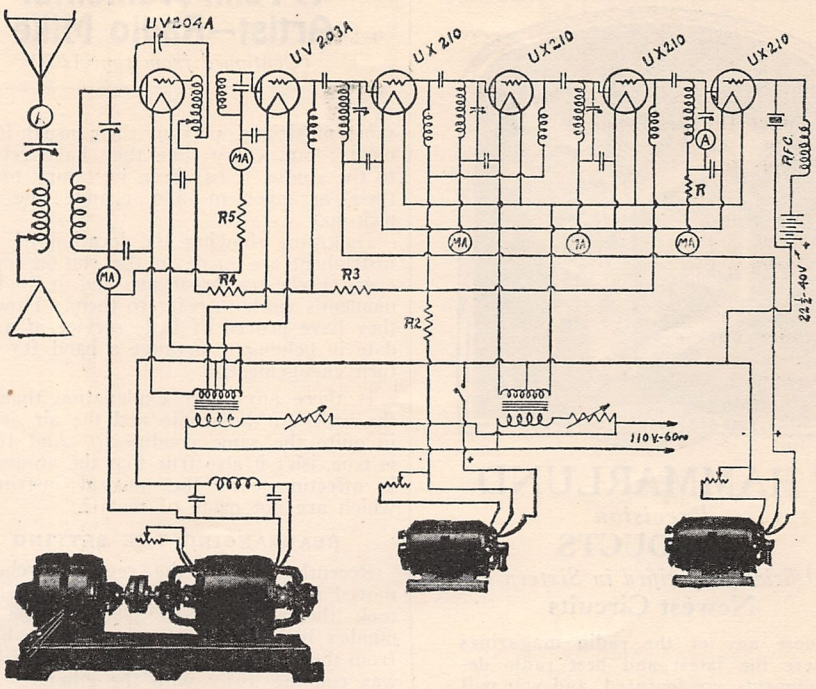
A RADIO THEATRE PARTY

NEW YEAR'S night in Minneapolis was featured by a party, the Radio Trade Association leasing a theatre with 2,200 seats and opening it to the public, who were invited to hear the reproduction of an evening's radio program through a large receiver and amplifiers. The other theatres were not enthusiastic over the competition.

FREE AERIAL MASTS

TO improve the appearance of the neighbourhood, Chislehurst Urban Council is supplying householders with neat wireless (radio) poles of an even size.—*News of the World,* London.

The readers of RADIO NEWS are invited to co-operate by the contribution of news items which concern novelties in radio or in the uses to which it may be put; especially those in which the element of human interest is found. Government announcements or press dispatches of general circulation will not qualify; send stories of something that has happened in your own vicinity. They should be short; for each one published $1.00 will be paid. Address News Editor, RADIO NEWS, 53 Park Place, New York City.



THIS is the fifth of a series of five "hook-ups" for crystal control transmitters using "ESCO" Maximum miles per watt Power Supply

This set requires a UX210 oscillator, three UX210 frequency doublers of the UX210 type, a 203-A power amplifier and a 204-A power amplifier. The crystal is a 320 meter one for 40 meter operation or a 160 for 20 meter work. Filament supply comes from two filament transformers, one for the 210s and another tapped for 11 and 13 volts for the 203-A and 204-A tubes. Plate supply for the 210s is obtained from Item 8, a resistance in the plate circuit of the oscillator tube producing the necessary IR drop to supply the tube with only 300 volts. Plate supply for the 203-A and 204-A tubes is obtained from Item 22, resistance R5 supplying the drop, allowing 1000 volts to be used on the 203-A. Grid bias for the tubes is obtained from Item 4 with IR drop resistences in those circuits requiring less than 400 volts. The grid bias for the oscillator tube comes from a block of B battery.

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is a complete treatise on the subject. It is full of practical information for superheterodyne owners and builders. In addition to the very complete data, it contains full constructional details on the LR4, the latest

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Set of 4 full size drawings for the construction of the LR4, $1.00

(These drawings are the original ones and contain the latest improvements made by R. E. Lacault.)

Our service department can improve your receiver. Sets wired for power tubes, shielded, and re-built. Write for estimate.

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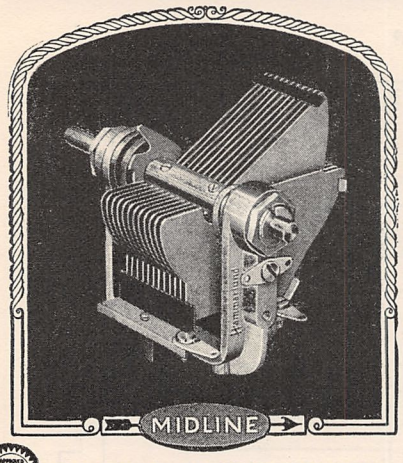

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A Temperamental Artist—Radio Mike

(*Continued from page* 1207)

same musicians, playing their usual instruments; but, every time they have returned to the studio, it has been necessary to alter their arrangement and change the mike pick-up.

Diagrams showing the location of every instrument are made in the station log for every orchestra broadcast and it is but a moment's work to refer to them. However, they have proved of little service at a later date in helping to arrange a band for a return engagement.

Is there any other explanation than that the walls of the studio and the air are not in quite the same condition? And if this is true, isn't it also true that the atmosphere is affecting even the musical instruments which are not made of metal?

REARRANGING THE SETTING

Recently one of the regular orchestras moved into the big studio and the members took their accustomed places. The first number had hardly started when the buzzer from the roof started an uproar. The banjo was running away with the ether.

However, it was being played by the same man who had been broadcasting every month for a year, and he knew his stuff. When the banjo was moved five feet further away from the mike its notes took their proper relative position.

Another freak comes to mind. There is a blind entertainer, appearing regularly on a program as a singer, who is his own accompanist. One week it isn't necessary to close the piano and the mike may be placed on its corner. The next time the mike must go to a far corner and the piano be closed. Sometimes it has even been necessary to restore the rubber cover to all except the keyboard. This man, being blind, has developed to a high degree the acuteness of his ears, of course, so it is not reasonable to believe that there is so much variation in his performance.

Be patient, give them five minutes. Maybe after the last piano solo the heavy rubber covering has not been restored to the piano and that instrument's strings are vibrating in unison with the violin or banjo. Possibly the sounding board of the piano is picking up some note to send it reverberating into the mike. The mike can't well be moved, for you'd think your house was tumbling down, so great would be the thump when the stand was set down. And so that number goes to its conclusion in agony. Then there is a little longer wait than usual after the announcement, and the next selection comes through as it should. The mike has been moved, the piano covered up, the side curtains rearranged, and so on.

By the time these troubles are overcome, as likely as not, there is an altogether different type of number on the program, and so the studio director and announcer may be standing on their heads again. At times an evening will become a nightmare, but none of it gets to the invisible audience; the listeners hear none of the long hours of rehearsals that precede a program, or of the trouble that comes from last-minute program cancellations.

There are all sorts of things like these constantly bobbing up, but the station personnel takes them as all in their day's work—which is providing you with a high brand of entertainment in your own home, every night of the week, and for which they do not always get even your thanks.

Remember, five minutes and a kind word once in a while are little in return for what we get. Let's give them both.

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I Want To Know

(*Continued from page* 1260)

"Start oscillator and set on wavelength to which the receiver is adjusted so note will be heard in the loud speaker.

"With a wooden-handled, hard-rubber or bakelite screwdriver or wrench as described, loosen balancing condenser No. 2, meanwhile rotating No. 2 dial rapidly between thirty and fifty degrees. A click will be heard as the set goes into oscillating condition. Next tighten No. 2 balancing condenser screw until click just disappears, then tighten up about one-quarter turn beyond.

"Set all dials at 40, rotate No. 1 dial rapidly between 30 and 50 degrees, following same procedure on No. 1 balancing condenser screw as described for No. 2 balancer. If the click cannot be balanced out readily, a slight further adjustment of No. 2 should clear it up.

"Leaving receiver still set for high range, turn all dials to 20 degrees, reset oscillator on wavelength to which the receiver is now adjusted. No oscillation should be experienced; if such a condition exists turn in slightly more on No. 2 balancer. Continued oscillation would be a likely indication that balancers No. 1 and No. 2 were turned slightly too far in past the click. The first balancing operations already described should be repeated.

"If no oscillation is apparent with dials at 20 degrees, set switch for 'low range' and turn dials to 65 degrees. Reset oscillator as previously described. If slight oscillation occurs, effect readjustments of No. 1 and 2 balancers. If there is tendency to oscillate on the high range, screw in No. 1 balancer slightly further. If set tends to oscillate on the low wavelength, screw in No. 2 balancer slightly further. This procedure should be repeated if not successful with the first attempt.

"After these two balancing condensers are adjusted to their final positions, the third dial readings may be made identical with No. 2, should a marked variation be experienced.

"Tune your oscillator until it is heard between 10 and 20 on the dials. Note the dial readings of condensers 2 and 3. If the third dial reads higher than the second tighten the balancing condenser No. 3 until the readings coincide with those of the second. This adjustment will have little effect on dial settings at high wavelengths.

"The suggestions given below may assist in clearing up further difficulties that may arise.

"While it is advisable to balance the set with a high-plate voltage and full filament brilliance, any receiver which will pick up stations or the oscillator tone without distortion with the volume control at 4 and 90 volts on the 90-volt terminal is satisfactory; since these are the conditions under which the set will operate.

"If the set refuses to balance, and the click does not disappear when adjusting No. 1 balancer, a defective 'B' battery by-pass, below rated capacity, or defective antenna coil, may be the cause. An exceedingly large aerial will make the set critical to balance.

"If no click is heard from the second stage at the beginning of the balancing operation, the filament voltage may be low, or reversed, or the 'B' voltage low. The tube may be poor. A tube that will not oscillate up to the highest wavelengths on the dial when the balancing condensers are released is not active enough to use in balancing. The second binocular coil may be damaged or defective and in need of replacement. The primary may be open (which may be determined by the electrical-circuit test) or part of the primary shorted out, or the litz secondary damaged.

"Unbalancing below 200 meters will probably not be serious and need not be corrected if such correction would endanger the stability on higher waves; since the set is not being used for broadcast reception below 200 under the present regulations.

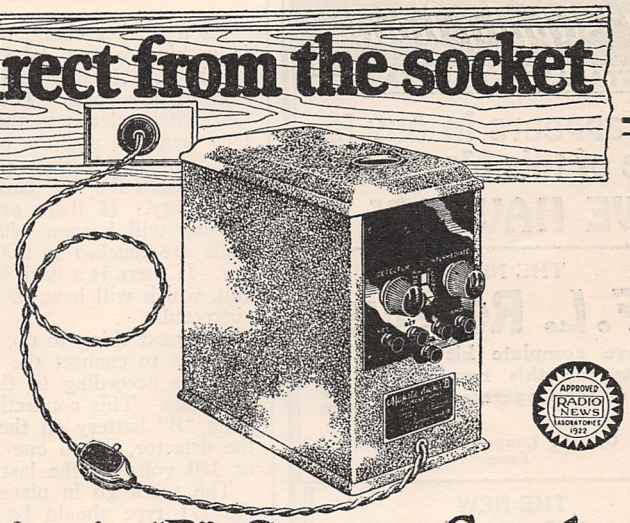
"If the set oscillates when the screws are released, and responds to the balancing operation as described, but signals are weak, after checking voltages, wave-range switch, etc., look for an open tap on the antenna coil or damaged secondary winding."

THE PSALM OF RADIO

Radio is my hobby: I shall want no other.
It maketh me to stay home at night.
It leadeth me into much trouble.
It draweth on my purse.
I go into the paths of debt for its sake.
Yea, though I understand it perfectly, it will not oscillate.
Its concerts and speeches, they comfort me,
Yet it will not work in the presence of my friends.
I anoint the coils with shellac:
But the tube spilleth over,
Surely the bug will follow me all the days of my life,
And I will dwell in the house of a radio fan forever.

Contributed by John R. Elliott.

Direct from the socket



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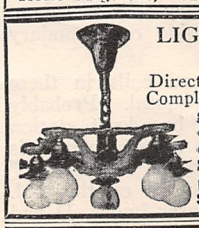

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The Loftin-White Receiver

(*Continued from page* 1244)

As a further check, to be sure that there is nothing wrong, take the terminal wires of the "A" battery and touch them to the "A" battery posts. Then touch one of the "A" battery leads to the negative "B" battery terminal, and the other to each of the positive "B" battery posts in succession. Then touch the "C" battery connections the same way. If there are no short circuits nothing will happen when the "A" battery leads are touched to the posts in this manner. If there is a flash it means a short circuit, which will have to be traced down and corrected.

The next thing to do, if everything is all right, is to connect the "A," "B" and "C" batteries according to the markings in the drawings. This connection provides for 90 volts "B" battery on the R.F. tubes, 45 on the detector, 90 on one A.F. tube, and 135 or 180 volts on the last tube.

The tubes go in place next. A tube of the 171 type should be placed in the last stage socket, if 180 volts of "B" battery is to be used with a 40-volt "C" battery. If 135 volts of "B" battery with 9 volts of "C" battery is to be used, then a tube of the 112 type should be placed in that socket.

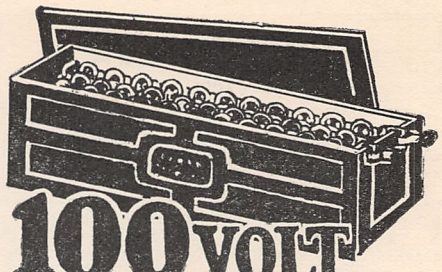
Now it is about time to connect up the antenna and ground, and to plug in the loud speaker. The antenna should be about 75 feet in length from the receiver to the far end. After this the switch and the rheostat knobs on the panel front should be turned to the right. The tubes should light up and the loud speaker should produce sounds. If, when the condenser knobs are turned, excellent results are obtained from all broadcasting stations within your normal range, the job may be considered entirely complete.

SETTING THE CONDENSERS

The first purpose of the Loftin-White circuit is to transfer all radio frequencies equally well, so that all broadcast stations within the broadcasting band can be brought in with volume in proportion to the strength of signals they lay down on your antenna. The second purpose of the circuit is to prevent the R.F. amplifier tubes from oscillating and producing distorted broadcasts. These results are obtained by carefully adjusting the phasing condensers, C4 and C5, with a screw driver, and by adjusting the coupling screws on coils L1 and L2 just back of the top corners of the front panel. The phasing condensers are at the front center and right end of the base panel; their adjusting screws are in the middle of their tops.

Now we will suppose that the parts are out of adjustment; say the phasing condensers are screwed down too far. If they are, the set will squeal. You cannot see whether or not they are down too tight or up too loose; therefore, the best way is to screw them down tight. We can tell when they are tight, but when they are loose we cannot tell how loose they are. Also, to get the same starting place for the coupling coils even though it may be the wrong place, suppose we screw them up or down so the tops of the inside or primary coils are about on a level with the outside or secondary coils.

With the condensers and coils in these conditions the set should squeal. Probably it will squeal for every broadcast station between the shortest (200 meters) which is at about 10 on the dial, to the longest (547 meters), which is at about 97 on the dial. That is, if the two condenser knobs, D and D1, are turned at the same time, a squeal should be heard at several points on the dials, say when both dials are on 15, 25, 35, 55, 75 and 90. At least there should be



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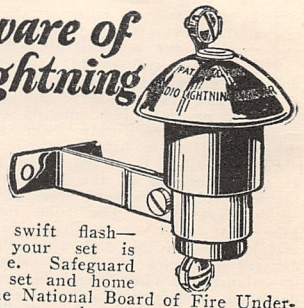

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Don't let this happen to your set.

one station broadcasting on a wave length near 15, and another near 65, and another near 90. Of course, both dials may not be exactly on the same figures. Tubes, windings and other things change the settings somewhat.

The next operation is to turn the two dials to the station that causes a squeal near 65. Then loosen the set screw on the right-hand tuning condenser shaft at the front end of the coupling, CP, and turn the *coupling* disc with one hand while holding the right-hand knob with the other. Fiddle these back and forth until the squeal comes in loudest, then tighten the set screw in the coupling. If the squeal is too loud to judge by, turn the volume control rheostat, R1, to the left and then make the adjustment.

After the tuning condensers have been adjusted as above, turn the volume control, R1, to the right again and turn both condenser knobs to the squeal near 90 and then to the squeal near 15. Then turn the volume control to the left until the squeal near 15 disappears. Next turn back to the squeal near 90. Now one of two things is to be done: first, if the squeal is still there, turn back to 15 and move the primaries of coils L1 and L2 into the secondaries until the squeal comes back at 15. Second, if the squeal is not there at 90, turn back to 15 and turn the volume control to the right until the squeal comes back and no further. Then raise the primaries out of the secondaries slowly until the squeal disappears.

Now turn the volume control all the way to the right, leaving the dials on 15. Next take a screw driver and alternately turn the screws in the two phasing condensers, C4 and C5, one-quarter of a turn to the left until the squealing stops. Now turn the dials slowly across the scale. If no stations squeal but come in as they should all the way across the scale, nothing further needs to be done in that respect. If they do squeal at some point, loosen up on the phasing condensers alternately, a quarter of a turn at a time, until the squealing ceases.

The two variable condensers on the right-hand knob may be set more accurately now, by turning to a weak station or one that is weakened by turning the volume control to the left. While this weak signal is coming in, loosen the set screw on the front-end of the coupling, CP, between the shafts and by turning the coupling disc with one hand and the knob with the other, adjust for the loudest sound from that weak signal, and then tighten up the set screw.

All of the above is to correct for several possible errors, for example, the differences of tube capacities, also the variations in coils and condensers. These directions should be read over carefully at least twice, and then followed step by step. Like every new thing, it is puzzling at first but easy later.

Of course this squealing process is a bad method to use, in one respect at least, because when the receiver is in that condition it can bother the neighbors. Therefore, it is desirable to complete the adjustment as quickly as possible, and at a time when very few people are listening to broadcasts.

Any receiver kit can be connected up wrong, and this receiver is no exception. If connections are run to the wrong place the wrong effects will be produced. In general, the usual wrong results will be obtained if this kit is improperly connected up. However, there are some improper connections and adjustment results that can be obtained in this receiver, which will give different results. For example, if L1 or L2 is connected backwards, the receiver will be nearly or entirely dead at about 300 meters, which is about 50 on the scale. If the phasing condensers are screwed down too tight and the primaries of the coils L1 and L2 are too far out of the secondaries, the receiver will squeal on long wavelengths and not on the short, which will seem odd because other

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The motive of this unsolicited testimonial is pure gratification and enthusiasm, as well as appreciation of the truthfulness of your claims which are straightforward and honest; something which I regret to say, does not apply to a number of other people in the radio business.

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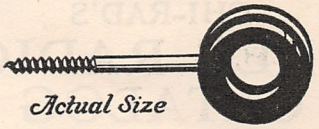

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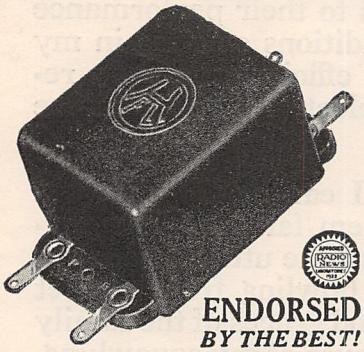

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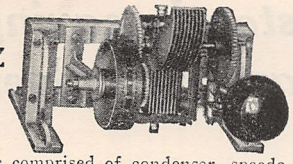

Each unit is comprised of condenser, speedometer type drum and dial and worm gear assembly for tuning, all on a single shaft mounted on a strongly built, channel shaped aluminum casting.

Perlesz Condensers are die cast, the stators and rotors made each in a solid piece. They are perfectly uniform, the air gap absolutely constant and unapproached for accuracy. A small compensating device at back of each condenser provides for finer adjustment after set wiring.

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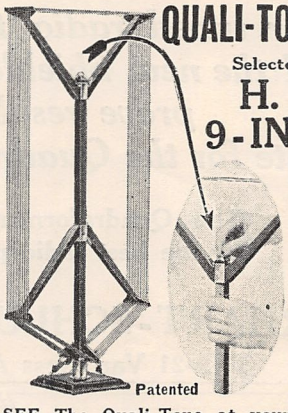

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NINE - IN - LINE SUPERHETERODYNE

receivers usually squeal on the short waves.

Now as to operation: there isn't much to be done. After the parts are properly connected and adjusted it is simply a matter of turning the two dials to the stations. Of course, in "fishing" for distance, for example with headphones plugged into the jack, J, it is a good plan to turn one dial slowly with one hand and the other dial back and forth over the same numbers with the other hand.

Progress in Radio

(*Continued from page* 1254)

coil deriving voltage from a "B" battery; the primary coil being also connected between the plate and grid of the tube, and the coupling having its coils balanced. It is found that this balance is obtained when the turns ratio of the coupling coils is 64 to 89.

The first tube acts as an ordinary back-coupled detector, and the signal impulses are also led at radio frequency directly from the aerial to the plate of the second tube, and to the grid of that tube through the primary coil of the R.F. coupling, across which a condenser is shunted. Audio currents are transferred to the secondary coil of the R.F. coupling and are led therefrom to the plate of the third tube and also to the grid of that tube across an iron-core transformer.

The following are the values of the components used; the secondary coil, X, forty-five turns; primary coil, P, of the R.F. coupling, sixty-four turns; secondary coil, S, eighty-nine turns; A.F. transformer, T, a ratio of about ten to one; fixed condenser, C, capacity .002-mf.; and loud speaker condenser, K, .005-mf. As in some other circuits of an unusual nature it will be noted that the "B" battery is placed directly across the telephone terminals. Great amplification and absolute stability are claimed.—*Wireless Trader*

Gentlemen Prefer Broadcasts

(*Continued from page* 1219)

more soothing to my eyes than the black ones were. I can't explicitly state why, but they do."

I takes his word for it and puts in my opening line.

"Well, what's the big benefit going to be?" I inquires.

This crack is a stock gag between us—you have to use stock gags on The Master; originality is simply lost to eternity—and it means, translated, "What is your newest invention and for Heaven's sake, why?"

Jerry smiles. "Oh, you can't expect me to have a new idea every day, Joe," he remonstrates. "However, as it happens, I am working, rather vaguely, on a principle I conceived almost five years ago and filed away due to lack of material. I ran across it in cleaning out my desk yesterday."

"Does it work?" I inquires, innocent.

The Master almost laughs outright, which is saying a lot for him. "Hardly as yet, Joe," he replies. "To be specific, my idea concerns a radio weather control."

"No!" I gasps. "Don't fool me, please!"

"I am quite serious," says Jerry, and he is—never being much of anything else—so I gives him the air. "However, I have done nothing towards materialization of my device because of a very basic handicap. One principle of operation is, for the time, beyond my reach."

"Get a ladder," I advises, but it sails way up and out the transom. My best remarks are invariably wasted on Jerry, but I'm keeping on, hoping some day to put a point over. But The Master continues.

"Such a thing as radio weather control is not precisely new," begins Jerry, unrolling a musty sheet. "In fact, there has been much discussion as to whether ordinary radio does not interfere with the elements. Sun spots have also been credited with spasmodic weather, and there is electricity in sun spots."

He lays the paper down on the drafting table, and it don't mean much more to me than an unexpurgated set of early Cretan hieroglyphs. I see, though, that there's a lot of old-fashioned apparatus in it, and remark to that effect.

"Oh yes, the years have wrought a great change in radio parts," he admits. "This outfit, as outlined here, would be emphatically banned were I to use it today. It employs fifty kilowatts through an immense rotary spark gap."

"Almost as bad as a Ford coil," I lets loose. The Master eyes me in astonishment.

"*Almost* as bad—oh, you were indulging in levity," he discovers. Really, Jerry is getting to be much quicker on the gag pick-up since he's been backstage with the *Inanities*. His average time is now only three minutes and forty-two seconds.

The Master continues. "The first principle upon which this system operates—or was to have operated; I never attempted a demonstration—is that radio waves, being electrical in nature, must carry heat, and that heat, if properly concentrated, will always dry up moisture. My handicap on this first principle was due to lack of ability accurately to direct radio waves. Today I am in a much better position to do this, although I shall be bound to interfere with someone's radio reception, due to the large transmitter input necessary. However, it is not the first principle which has bothered me, although it is complicated enough. It is the second principle, which I am as yet unable to discover.

"You see, Joe, the first principle will drive away rain—assuming, of course, that it operates satisfactorily—but I have no means of attracting rain. The second principle would cover this part of the device, and is obviously very necessary to the completion of the radio weather control. It would necessarily have to work both ways."

I nods. "Quite true," I agrees. "However, in case you can't grab the accolade as a rainmaker, you can sell the fair weather control to a lot of amusement parks and out-of-door concessions, and also to many private parties."

"Doubtless," answers Jerry. "But the financial aspect does not at all intrigue me. And again, I have no intention of placing a weather control in each home—one control for every two hundred square miles is about the minimum that I feel safe in guaranteeing—for you can readily conceive the result if one man wanted fair weather for his golf and the other needed rain for his garden. Just which would have his way would depend upon the size of the transmitters in use, and chaos would be the result. No, Joe, this system, if perfected, will have to be under government control. Then the weather man could be relied upon."

His point is clear enough. "I get that much," I states. "But have you any angle that you hope to get your second principle from?"

"Not a single suggestion," he says, slow and deliberate. "But I am in no hurry about it. And by the by, have you a rehearsal tomorrow morning?"

"Why, yes," I replies. "Why?"

"Oh, nothing very important, except that I'd like to go in with you and make a few tests of the acoustics in the theatre," he says. "I've been working, rather lackadaisically, on an improved loud speaker, built on the principle of more than one

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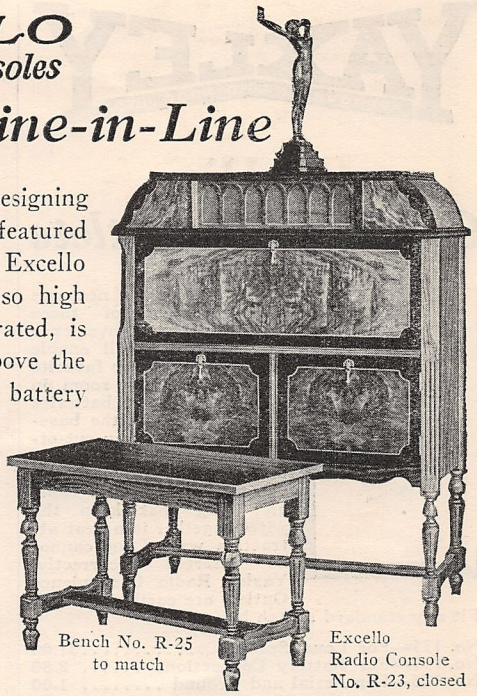

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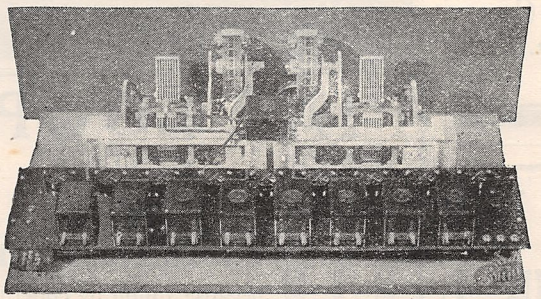

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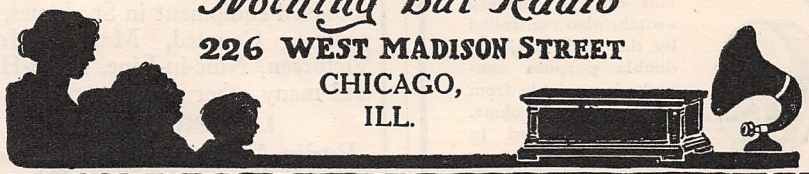

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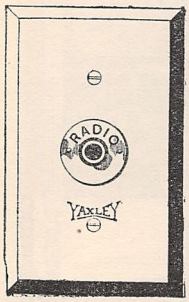

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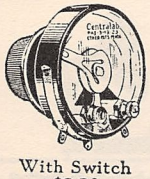

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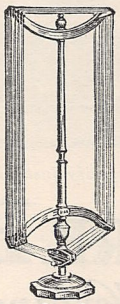

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ANOTHER FIRST FOR RADIO NEWS
The Nine-in-Line Superheterodyne

NINE - IN - LINE SUPERHETERODYNE

resonating surface. I had a vague idea I might garner a few points from listening to the practice, when there was no audience in the house."

I grins. 'Sure," I invites, "come right along. You're always welcome."

And he is, having been backstage often and being well liked. His presence don't excite any great amount of curiosity, but it does stimulate the ladies of the ensemble, all of whom try to vamp him because he's rich. They can't kid him, because he don't understand; they can't be serious with him without making themselves look more like fools than they naturally are. But they tries hard, and thereby hangs a tale.

Every so often a new chorus girl comes into the cast; we have three this morning, which is the principal reason for the rehearsal. Two of the newcomers are only as beautiful as Venus; the third, however, is listed on the Stock Exchange—not the curb—as a Blonde, preferred. Maybe that makes it clearer.

Well, it don't take the gang of gum-muzzlers ten minutes to slip the recruits all the low info about The Master having the combination to a dozen bank vaults. Equally sudden the two Venuses try their charms on Jerry, falling flatter than a wise crack in Duluth. But the minute blonde don't even give him a tumble.

Now, The Master ain't conceited about his looks—doesn't know he's got any, from appearances—but he has sort of become used to being pawed over every time he comes around backstage at the show. The new girl barely nods at him, and child-like, he wonders why. Being, by nature, of scientific inclinations, he starts in to find out why. Simple psychology, if that puts over the point.

So Jerry stays with us all morning, which is unusual enough, but honestly, I don't for a minute give things a serious thought until, right out of a clear fly-loft, The Master asks the little blonde to lunch.

In the several months we've been tapping on the Pay White Way Jerry hasn't even as much as offered one of the girls a stick of gum. And for him to ask a girl to eat is as rare as a loop aerial on a crystal set. The cast is too astounded to speak, and they hops out. Later I learn they went to the Astor.

"Can you tie that blonde?" snaps Betty, also a member of the peroxide trust. "What is this 'it' I hear so much about?"

"Evidently the blonde has 'it'," murmurs Tap ones. The whole bunch is almost stupefied.

That's the last we saw of Jerry that day. At the evening show the blonde comes in alone. Her name, for the sake of convenience, is Helen Robbins; by the end of the week the gang's referring to her as "Cat"—short for catastrophe.

For The Master comes into town daily, and if I ever lamped a sample of the genus male in the throes of thousand-watt amour, Jerry is him. Helen doesn't seem specially enthusiastic, though affectionate as becomes one under the circumstances. The Master's a nice fellow, and it's his own business, so I don't quiz him about the affair, though I almost burst from the strain. Helen won't say anything important, so the first real inkling I gets as to how serious matters is happens when I takes my regular Sunday morning constitutional over to Jerry's, a week later. The laboratory is closed!

Personally, I always thought The Master's joint was like the café that threw away its key—Always Open. This is the first time that I've ever found it closed.

Jerry ain't home all day, so I has to listen to Doris' prattle about Mrs. Anderson's operation, and where the youngest Davis girl is said to be engaged to the red-headed soda squirt at the Emporium, and how old John Burnett's rheumatism has attacked his ears from too much listening to the radio—indeed, it's all very interesting, if you're still with the morons.

Finally, about eight o'clock that night, human nature can't tolerate any more, so I beats it across lots hoping against hope that The Master will be there. My heart leaps wildly as I jumps from crag to crag across the frozen brook, aha, our hero is there, for I see a gleam of light at the window!

Yes, The Master's there, and when I opens the door Jerry's in his old morris chair, and the look on his pan would be translated by anybody from a Zulu to an Eskimo as the inane glimmer of first love. The Master's got it, and very bad. I wants to sooth him.

"Come, come, Jerry, don't take it so hard," I suggests.

This is the first he's known I'm in the room. "Joe, old friend," he says, in a far-away voice. "Joe!"

"Out with it, like a good boy," I commands. "What's it all about?"

The Master rises to his feet. "Oh, Joe, I'm the happiest man in the world! She's accepted me!"

"What!"

"She's accepted me—Helen—oh, I'm so happy!"

I flops on a box. "Love me, boy!" I gasps. "For an amateur you sure do work fast! Engaged in a week!"

Jerry paces back and forth. "She's divine!" he murmurs low, like Los Angeles coming in through an old cone on a bad night. "Divine!"

I accepts the conditions as presented.

"We're to be married in a month," he says. "You'll be best man, Joe, and Doris bridesmaid."

"Yeh," I grunts.

Then The Master sheds his coat and rolls up his sleeves. "Now I can work," he declares, "and I'm sure that second principle will be forthcoming."

He busies himself, and it gets sorta like old times. But his mind still isn't on his work. I makes no further remarks that evening. He's in town every day the following week; the next Sunday he gets back to the laboratory about three in the afternoon. I skips over.

"Well, well, you're early today!" I greets him, supposedly sarcastic.

It's lost on him. "We had lunch, and visited awhile," says The Master. "I didn't want to leave, but I had to get to work on this principle."

I'm still shut, but I thinks I sees an idea fluttering along.

Jerry's in town the next day, Monday, but misses Tuesday altogether. I talks to Helen about it, but she merely smiles and says he's busy. He's in Wednesday, with flowers, but forgets about Thursday and Friday. Saturday is the day of apology, and then he lets a whole Sunday go by without seeing Helen. To make it worse, he also misses Monday. That night I sees that Helen's worried.

"What's the matter with Jerry?" she asks me. "Is he sick?"

"No," I says, "he's busy. Working on a principle."

Helen looks dubious. "Working?" she repeats. "I didn't know that he had to work."

"He doesn't have to," I says. "But he does. You see, science is his lifetime hobby, and always will be. He and the unknown are inseparable."

"Oh, are they!" remarks Helen.

"They are," I replies. She don't say nothing, but I ain't so dumb.

Tuesday morning he doesn't show up, so that afternoon Helen hies herself out to see what's become of her swain. He's knee deep in principles and almost throws a fit of joy at her arrival.

"My darling!" he exclaims. To hear The Master say darling marks the passing of the old era. Jerry apologizes, which Helen accepts in fairly good grace, seeing as how I'm present. So the next day, Wednesday, he's in for a while; then he doesn't show up until Saturday night. By this time Helen is a bit warm around the collar, if she had any on, and shows her discontent. But Jerry comes

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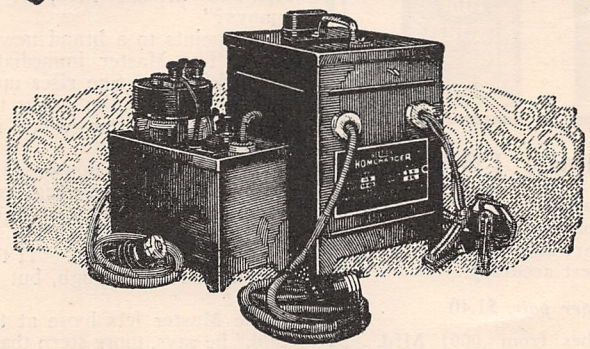

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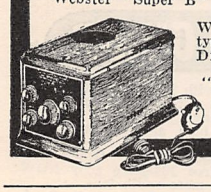

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in and takes her to a night club, and that soothes her a bit.

Then he runs five days without a break into town. That Thursday afternoon Helen takes another joy ride out to Brightmere. This time I ain't present, though I can see later that the fur evidently flew. Still, she's got the ring.

Jerry's in town Friday and Saturday, but Sunday the old urge gets the better of him and he stays home. Seeing as how he had a special date with Helen, this was a rank error in her mind, and she flies out to him, raging mad. I'm present, but she don't care.

"Listen, Jerry Lawson," she demands, "as a fiancé you're a dead flop. Do I get any attention around here, or do these do-funnys?"

She points to a brand new thermocoupler, which The Master immediately explains is not a do-funny. She rises up an octave.

"If you think I'm going to stand for all this nonsense after we're married, you're crazy!" she yelps.

"Why, it's not nonsense, dear," defends Jerry, showing surprising strength of character for one in his apparent condition of the heart.

"It is!" snaps Helen. "If this were a business it'd be bad enough, but just—just *playthings!*"

The Master lets loose at this. "My dear child," he says, more stern than I've ever seen him, "you must understand that these are not playthings! They are the results of some of the greatest minds the world has ever produced!"

"Playthings!" repeats Helen, like a spoiled kid. "I tell you, I won't stand for it!"

"Indeed! And if I tell you you shall?"

She lets fly at him with her fist, striking Jerry a neat smack on his jaw. As he steps back, dazed, she tears off the ring and throws it at him.

"You—you cheap skate!" she cries, and runs out the door.

For a moment Jerry's in sort of a coma. Then he removes his hand from his face, stares at it a moment, and slowly begins to grin. I starts to grin, too, but I see's we've two different things in mind. For with a whoop The Master comes to.

"Joe!" he yelps. "I've got it!"

I'm not surprised. "Meaning your freedom?"

"No! No!" cries Jerry. "My weather principle control!"

"What!"

The Master leans against the bench, gasping. "Joe," he pants, "while you were in France, during the war, did it rain?"

"Ask me riddles," I replies. "I lived in mud. Why?"

"Do you know why it rained?"

I shakes my head. "Because," I answers, feminine-like.

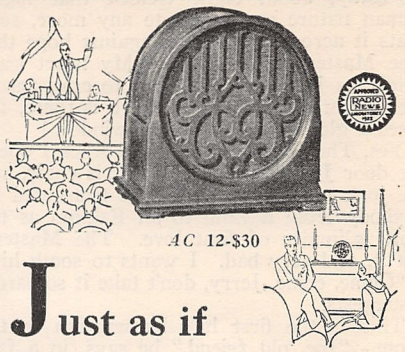
"No!" shouts Jerry. "Joe, ever since the invention of gunpowder, rain has nearly always followed a hot battle!"

I scratches my head. "I've heard of that," I admits, "but why?"

The Master's in high glee. "Why, there's my principle—*concussion!* The moment she slapped me it came to my mind. I'll simply force two elements of opposite wavelengths to vibrate at such a high, enormous rate that the effect on particles of moisture will be identical to that of cannon. In short, artificial thunder."

I muses a moment or two. "Adroit," I conceded, "but just what are you going to vibrate, and how?"

"I don't know—yet," admits Jerry, frank. "But here's food for thought. Vibration is the key to existence. Human beings vibrate at about 2,000 cycles. Animals can receive sounds up to approximately 10,000 cycles, birds about 15,000, and insects as high as 22,000. This information is not precisely accurate, but it is sufficiently proportional for my demonstrations. You see, human beings could not hear thunder vibrating at 22,000,



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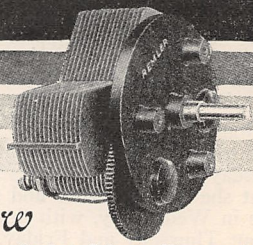

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yet it could feasibly be a means of attracting the moisture. It will all be cleared up by experiment."

I let that sink in a few megohms. "But what about Helen?" I asks.

The Master looks up. "About whom?"

"Helen—your former fiancé?"

Jerry pauses just the fraction of a second. "Oh, yes, Helen. A very dear child, but much too temperamental, I fear. Obviously we could never have got along together."

"Brilliant!" I commends.

"Oh, not at all," modestly disclaims The Master. "Although I must thank her for the inspiration for my second principle."

"But didn't you love her?" I asks, astonished.

The Master picks up his glasses, and I sees they're the old black ones. "Dearly," he says, and I sees it's true. "But can I leave my science, my art and life, for mere human affection?"

I'm silent a second. "You might say, it's 'love me, love my radio'."

Jerry smiles, faint. "Yes," he agrees, "you might."

QRA'S WHO WILL QSL

5FF—HERSCHEL R. CALER, Box 14, R. 2, Springdale, Ark. 40 meters.

7ACN—JAMES L. YOUNG, 303 13th Ave., So., Nampa, Idaho. 7½ watts, CW. on 40 meters. QSL's appreciated. All cards and "worked" answered.

7QA, 7QY—DON McKEETH, 412 Seventeenth Ave. So., Nampa, Idaho. 50 watts, 40 meters, R. A. C. C. W. 5-watt or 201A portable on 40 meters, 200-volt "B."

8CDC—CHAS. LALLEZ, 605 William St., Buffalo, N. Y.

9AEJ—E. W. BEATTY, R. 4, Falls City, Neb.

NP-4KD—E. W. MAYER, Box 103, Ensenada, Porto Rico. QRK mi 201A?

A Simple Inexpensive "Ham" Installation

(*Continued from page* 1258)

eter and the other 3½. The antenna winding is wound on the smaller tube and consists of approximately eight turns of No. 14 seven-strand antenna wire, space wound. The primary or grid winding is wound on the larger tube, and consists of eight turns of the same wire with a tap taken off at every turn. This will permit satisfactory operation up to 40 meters in conjunction with the .00015-mf. variable condenser. If 80-meter or higher wavelength transmission is desired, either the size of the condenser or the number of turns on this coil should be increased. The oscillation transformer may be constructed in the present approved style; *i. e.*, spiral pancake. The design and construction of an oscillation transformer of this type illustrated (Fig. 3) in the article entitled, "On Short Waves," published in the March, 1927, issue of RADIO NEWS.

The radio-frequency choke coil consists simply of 200 turns of No. 28 or 30 D.S.C. wire wound on a tube one inch in diameter.

ADJUSTMENT

The antenna and primary condensers should be rotated slowly until a resonant point is reached. This will be indicated by a deflection in the radiation ammeter, or by a sudden drop in the space-current reading, measured by the milliammeter. If, after the wavelength has been checked, the emitted wave is found to be too high, simply continue to rotate the two variable condensers towards minimum capacity until resonance and the proper wavelength are obtained. The two condensers are rotated towards maximum capacity if the wavelength emitted is too low. The transmitting key must, of course, be depressed during the adjustment process.

For short-wave operation it is suggested that a short antenna be employed, one not

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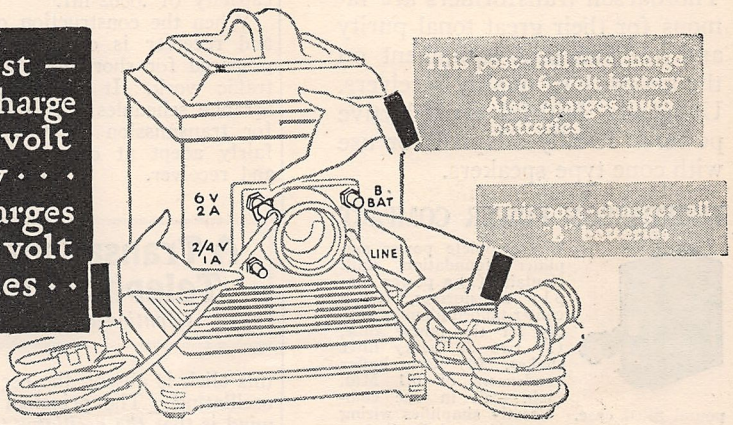

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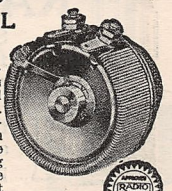

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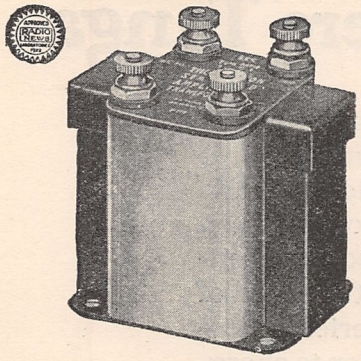

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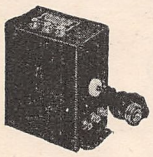

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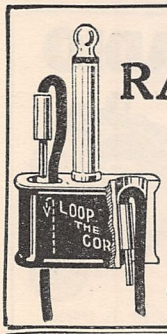

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exceeding 60 or 75 feet, including the lead-in.

THE RECEIVER

Any efficient type of short-wave receiver may be used. We recommend one that employs the plug-in type of coils so that the same set can be used for the reception of any signals between the wavelengths of 15 and 600 meters. A schematic wiring diagram of an efficient plug-in coil receiver is given in Fig. 1. Its design and construction are very simple, only one coil and two variable condensers being employed in the entire tuning circuit. The simplicity and neatness of the receiver are shown in the picture of the outfit, Fig. 3. A small midget balancing condenser is connected in series with the antenna and helps to reduce the tendency of the receiver to oscillate violently. It also minimizes other critical effects.

The grid winding consists of approximately 20 turns of No. 24 D.S.C. wire wound on a plug-in type form 2 inches in diameter. The plate coil also consists of approximately 20 turns of the same size wire, and is wound alongside of the grid winding. The two variable condensers employed should preferably be of the S.L.F. type, each having a capacity of .0002-mf.

When the construction of the transmitter and receiver is completed, the amateur is prepared for short-wave communication and traffic work. It is suggested that he prearrange schedules with other local amateurs for transmission practice until he becomes fairly adept at operating both transmitter and receiver.

A Transatlantic Radio Telephone Receiver

(*Continued from page* 1264)

this click is absent, the oscillator tube is not oscillating. The principal point to bear in mind is that *the oscillator tube must oscillate and the first tube of the non-regenerative set, V1, must not.* When this condition has been met, the signals should come through clear and undistorted.

As mentioned previously, the four-tube receiver here described is primarily intended for long-wave work; however, it will give very good reception on all wavelengths from 200 to 8,000 meters. The accompanying table shows the values of honeycomb coils for use with a .0005-mf. condenser to receive the various wavelengths. From this table can be computed the coil values for any particular band of waves that is desired to be covered. When receiving regular broadcast programs the oscillator tube, V2, and its accompanying coil, L2, are unnecessary. By removing these from the circuit we have a good three-tube non-regenerative set well adapted for broadcast reception.

Range of Wave Lengths

Coil Number Duo-Lateral	Wave Length in Meters Min.	Max.
25	30	285
35	35	365
50	55	530
75	80	790
100	105	1050
150	155	1570
200	205	2070
250	265	2680
300	330	3330
400	430	4310
500	560	5600
600	655	6550
750	800	8050
1000	1110	11200
1250	1420	14300
1500	1730	17300

CORRECTION NOTICE

In the article, "New High Resistances for Radio Circuits," in the March issue of RADIO NEWS, there was an error in the size of the glass filament used in the units. This should be 0.02 of an inch instead of 0.001.

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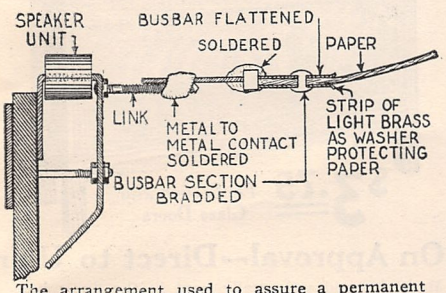
A Ship-Model Loud Speaker

(*Continued from page* 1229)

out a section of the deck so that the loud talker unit might rest in the hull of the ship. The unit used in this speaker was developed particularly for use in operating a 3-foot cone, so that it has abundant power to vibrate the sail and produce a considerable volume of sound.

In later designs of this same general type, it has been found advisable to raise the boom of the sail clear up to the "crow's nest," enlarging the sail in order to utilize as much sound-producing area as possible.



The arrangement used to assure a permanent connection between the loud-speaker unit and the sail-diaphragm is shown above.

The reproduction is most excellent, and the volume quite sufficient for home use.

Only one difficulty will be encountered in preparing this type of speaker from whatever materials may be at hand; it will be found in connecting the pin of the unit to the edge of the sheet of paper. It was accomplished, as you will see in the drawing accompanying this article, by firmly attaching a small metal anchor plate, to which the link had been soldered, to the lower edge of the sail.

The upper edge of the sail is to be thumbtacked or glued to the boom; but the lower edge and the sides must be permitted to ride free, so that the vibrations will not be "damped" or transmitted to other surfaces.

CORRECTION NOTICE

The illustration of the hanging cone speaker, printed on page 952 of the February number of RADIO NEWS, was inadvertently credited to Dimmock-Bogart Radio, whereas it should properly have been credited to the Electravox Studios.

Radio News Laboratories

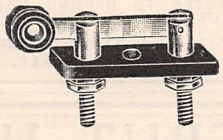
(*Continued from Page* 1257)

each layer is directly connected to the terminals.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 1919.

KNIFE SWITCH

The "Baby" knife-throw switch shown, submitted by the Leslie F. Muter Co., 76th Street and Greenwood Ave., Chicago, Ill., is small in size and de-



signed for panel and base mounting. Metal parts are of nickeled brass and the base of black bakelite.

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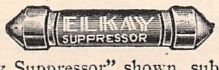
GRID RESISTOR



The "Elkay Suppressor" shown, submitted by the Langbein- Kaufman Radio Co., New Haven, Conn.

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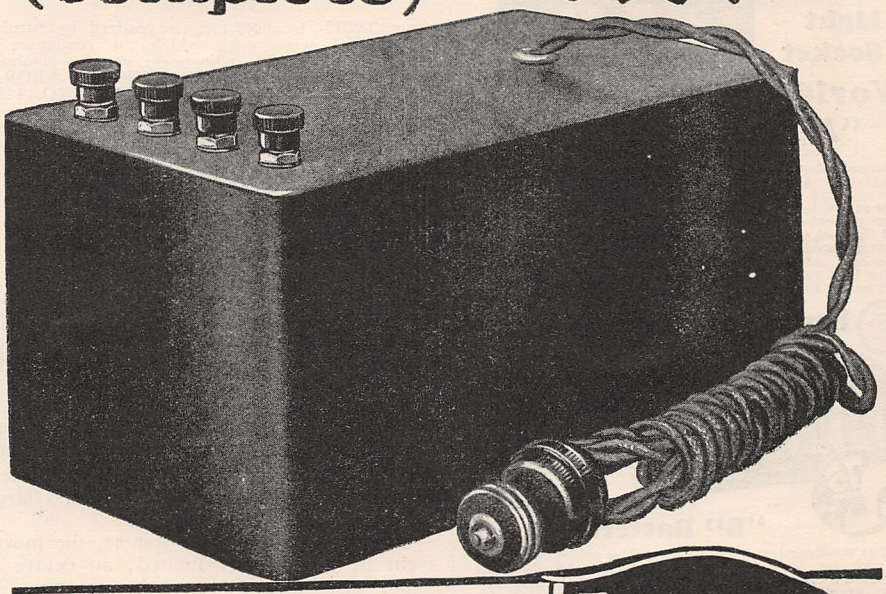

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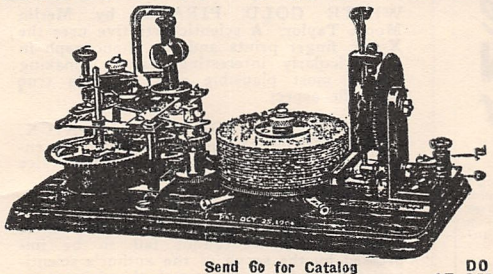

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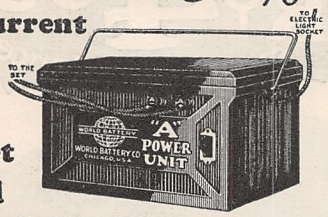

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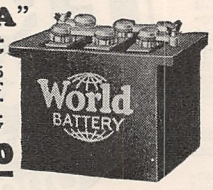

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VARIABLE GRID CONDENSER

The "Muter Variall" grid condenser shown, submitted by Leslie F. Muter Co., 76th Street and Greenwood Ave., Chicago, Ill., is of the "book" type. The housing is of molded bakelite and very neat in appearance. The variation of the capacity

from .00015- to .0005-mf., is realized by turning the special screw with which the condenser is equipped. Very fine adjustment can be obtained.

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How to Build the "Tromborad"

(*Continued from page* 1237)

This makes it easier to play tunes. The music is produced by moving the slide back and forth as you blow into the mouthpiece, just as is done with a trombone.

By changing the size of the condenser C the pitch of the note can be changed. In my case I used a .005-mf. condenser. The larger the condenser the lower the pitch, up to a certain point. If it is too large the tube will not oscillate.

The audio coil being so short, the movement of the slide is limited; an octave is about the range that can be covered. It may be suggested that those in a position to construct or wind a longer coil will find that one can be made just half the length of the slide. Then the range and movement of the slide will be increased.

In the construction of my Tromborad I used a 199 tube because that was the kind I had on hand; however, a tube of 201-A type can be used. I also used a single headphone for the "loud speaker." I would suggest the use of a Baldwin C type phone, as it will give more volume. Several other loud-speaker units can be had very cheaply; so the choice is left to the constructor.

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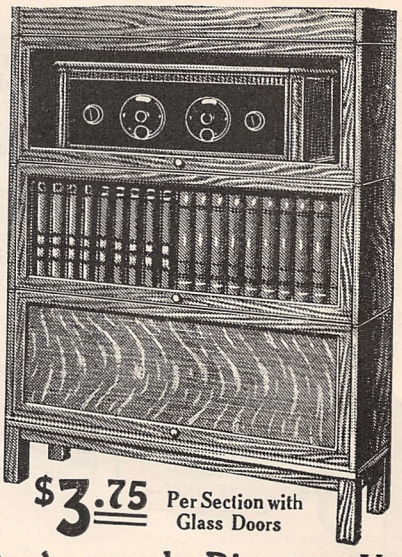

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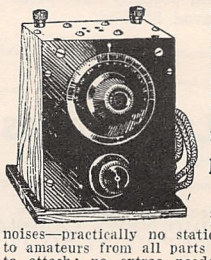

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What Do You See When You Hear Broadcast Artists?

(*Continued from page* 1210)

Now for a test of those three.

HOW THE LISTENERS SAW THEM

Let me give you a few answers taken at random from the pile of letters before me.

1. Mildred Wallack.
2. Hair, brown, blonde, blonde, black, black.
3. Eyes, brown, blue, blue, black, black.
4. Height, 5 ft. 6, 5 ft. 4, 5 ft. 4, 4 ft. 2, 5 ft. 6, 5 ft. 8.
5. Weight, 110, 120, 120, 118, 113, 100.
6. Age, 24, 21, 22, 20, 20, 17.
7. Nationality, American, American, American, Jewish-American.
8. Characteristics, light-hearted, artistic, versatile, pretty, aggressive type.

These comments are typical of all the answers on Mildred Wallack. It will be observed that nearly all thought her older than she really is, possibly because she acts and looks older. All gifted youngsters seem older than they are over the air. All, however, found her short, and came close to her weight. All found her to be an American, because her Russian ancestry does not show in her at all. On the color of eyes and hair, I think, the results are mixed. On characteristics nobody went wrong at all.

We will now take the second person analyzed above:

1. Earl C. Little.
2. Hair, black, blonde, gray.
3. Eyes, brown, gray, gray.
4. Height, 5 ft. 10, 5 ft. 9, 5 ft. 10, 5 ft. 11.
5. Weight, 165, 160, 165.
6. Age, 35, 30, 38.
7. German, English, American.
8. Pleasant appearance, staid, head erect, full chest.

Again the height and general physique of the subject were judged clearly by all. Little is younger than his years in every way, so he was found to be younger. His general characteristics as described were always right. Hair and eyes are a little difficult to guess.

And now for Miss Chaimowitz, the third of this group:

1. Annette Chaimowitz.
2. Hair, dark, black, blonde, black, brown.
3. Eyes, gray, black, blue, black, brown.
4. Height, 5 ft. 6, 5 ft. 7, 5 ft. 5, 5 ft. 5, 5 ft. 5.
5. Weight, 150, 165, 150, 170, 175.
6. Age, 20, 25, 22, 20, 32.
7. American, Russian, Polish, Russian.
8. Thick neck, ambitious, jovial, rosy cheeked, healthy.

With Miss Chaimowitz, everybody knew she was pleasingly plump and healthy, and that she is easy to get along with. Her height was clear, and her age about 90% right. Guesses at her eyes and hair were indefinite. At this point one observation might help clarify matters. Think of six people you know pretty well. Write down their names. Now quickly—what color eyes and hair have they? It is not so easy, is it?

Here are some observations which may be drawn from our little experiment at WRNY.

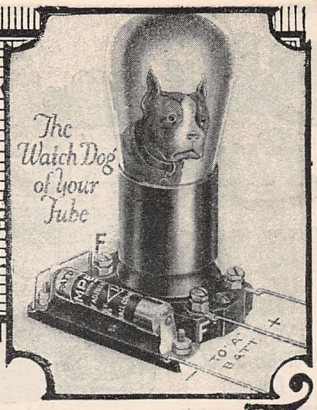
The voice is truly an index to the character and it accurately, in most cases, depicts the general physique of the speaker or singer. The speaker is better able to send his "picture" over the air than the singer.

Now for a general summary which I am certain will be interesting, especially if you refer to the group picture we took that night, of all whom we could hold until nearly midnight for the purpose.

The best "pictured" of the twenty was Thomas Pitt Grace, whose chart is as follows:

1. Thomas Pitt Grace.
2. Hair, gray, 75% correct.
3. Eyes, blue, 50% correct.
4. Height, 5 ft. 11, 80% correct.
5. Weight, 165, 85% correct.

FOOL-PROOF Filament Control



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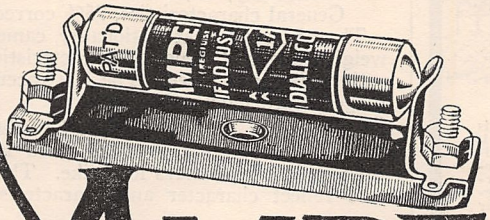

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6. Age, (about 65), 90% correct.
7. American, 100% correct.
8. Poet, reader, little crotchety, nervous, kindly, humorous, etc. 90% correct; average, 81% correct.

The poorest "pictured" of the twenty was Cookie Cohen, who is not in the group picture, unfortunately.

1. Cookie Cohen.
2. Hair, brown, 25% correct.
3. Eyes, brown, 35% correct.
4. Height, 5 ft. 6, 50% correct.
5. Weight, (about 145), 50% correct.
6. Age, (about 25), 20% correct.
7. Russian, American, 75% correct.
8. Singer, crooning type, reticent, etc. 50% correct; average, 43% correct.

Totaling everything, we find that the listeners were 65% correct on their "pictures" of all the artists.

This is the analysis:

Hair color, 40% correct.
Eye color, 40% correct.
Height, 70% correct.
Weight, 75% correct.
Age, 75% correct.
Nationality, 80% correct.
General characteristics, 75% correct.

Thus you see that nationality came first, weight, age and general characteristics ran a tie for second place. The least accurately judged were hair and eyes.

Now, from all this, it will be seen that listeners are getting a pretty good idea of what their broadcasters look like. The voice *does* reflect character and characteristics.

NEW FEATURES AT WRNY

Now if you please, just a brief survey of the month at WRNY. The first month of the new year brought many important new features to the station, including Roemer's Radio Gang, the Hardman Hour, the Level Club and many others. The Dance Series, with the big Dancing Carnival, directed by Vera Caspary, was an outstanding novelty.

The broadcast of Ibsen's "Ghosts" with Mary Shaw, John Knight and others, was declared by all who knew to be "the greatest broadcast of a play to the present day." The New York *Evening World* was particularly complimentary.

The "Radio Echo" French Lessons of the celebrated Mlle. Alice Blum are attracting a big audience, especially of American Legion boys. The Edison Hour series of "21 Adventurous Nights" is now one of the best known radio features on the air. WRNY cooperated closely with Thrift Week Committee and staged a Ben Franklin Party and other novel features. Perhaps some of you heard the big "Motor Boat Race" at our studio. George W. Sutton, the sports writer, headed the activities, and was assisted by Gold Cup racers. Other prominent names of the month are: Judge Rosalsky, William H. Rankin, Frank Mouland and Maj. Pechkoff.

Automatically Receiving Foreign Stations

(*Continued from page* 1206)

this almost human mechanism may be said to outwit the proverbial parsimony of government in stinting funds for radio research.

This laboratory, under the direction of Dr. Austin, is continuously engaged in the exploration of the fundamental secrets of radio. The vagaries of atmospheric disturbances as well as the inconsistent or erratic behavior of signals, especially those from long-wave, long-distance stations, are subjects of sustained concern to this laboratory. Dr. Austin, the head of this branch of radio research, is not circumscribed by narrow boundary lines when delving into phenomena of radio as a science, for his studies extend their ramifications across the Atlantic Ocean. At home and abroad he has a deep, unfailing interest in a work he began more than twenty years ago.

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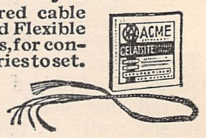

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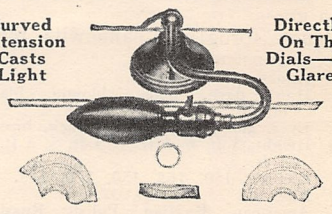

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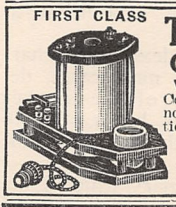

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A New Field for Experimentation

(*Continued from page* 1221)

carriers, notations will be satisfactory if made every five or ten minutes.

RECORDS FROM STATIONS

In Figs. 5, 6, 7, 8 and 9 are shown various carrier-wave curves of distant and local stations, as indicated. In Fig. 10 is shown a curve of KDKA's carrier, recorded when the station was broadcasting the Alabama-Stanford football game on New Year's Day, as received over a period of almost three hours, including the program after the game. This is a condensed curve of the one taken during this period, the time graduations being in minutes. The gradual rise in intensity ensued as darkness (nightfall) approached New York City.

In Fig. 11 are shown reception curves of WPG, (Atlantic City) as received in New York City on three consecutive nights. As explained, these curves are obtained by plotting meter deflections against time. If the time graduations are in minutes or half minutes, the meter deflection each half minute or minute is marked on the chart and the final curve drawn after the test period is over. This work is simple, and does not require any experience. The tuning of the R.F. amplifier does not differ from the convential methods used. The system prevailing when the receiver installation is utilized for regular reception holds good when it is utilized for carrier-wave intensity observations.

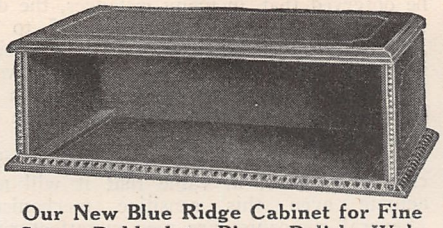
CALIBRATION METHODS

The daily calibration of the R.F. amplifier is a simple process. First a suitable place is found for the radio-frequency oscillator, a position which will not interfere with operations and in which the oscillator may remain during the entire period of test. This is necessary in order that the signal transfer from the oscillator output coil to the R.F. amplifier input coil may remain constant. The oscillator is adjusted to give constant galvanometer deflections at a definite wavelength setting. The switch in the aerial circuit is thrown so that the phantom antenna comprising the oscillator replaces the regular antenna-ground system. The galvanometer deflection and plate-milliammeter deflection of the R.F. frequency oscillator are noted. The R.F. amplifier is tuned to resonance with the oscillator frequency and the deflection of the microammeter in the crystal rectifier circuit noted. The filament and plate voltages applied to the R.F. amplifying tubes are also noted. Now the switch is thrown so that the regular antenna-ground system is in the circuit, replacing the phantom antenna. Keeping all D.C. applied voltages constant and the radio-frequency oscillator constant, again note the deflection of the microammeter in the radio-frequency amplifier system. These notations form a record of the amplifying power of the installation and must be verified each day, if accurate reception records are to be compared.

If, during the period of testing the installation, a marked difference is noted when the aerial and ground replace the phantom antenna, indicating a discrepancy in pick-up between two days, an examination of both the aerial and ground systems will be worthwhile. It is to be remembered that daily comparisons of received carrier intensity are of no use if the amplifying power of the amplifier changes. It is safe to assume that the operating characteristics of the crystal will not change, unless it is very heavily overloaded.

INTERESTING RESULTS

Observation by means of this apparatus will show the fan the insensitivity of the



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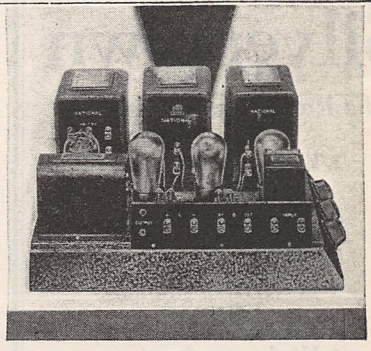

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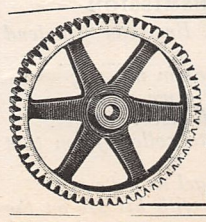

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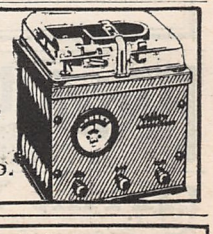

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human ear when sound is concerned. It will be observed that, in many instances, the deflection on the meter diminishes 25 to to 50% before an actual difference in intensity is noted by the ear. In many cases it will be observed that loud-speaker reception is being accomplished without any indication on the microammeter in the crystal circuit. In other words, the current in the crystal circuit is so small in value that it will not actuate even this sensitive mechanism. (Several companies are now manufacturing a microammeter with a full-scale deflection of only 18 microamperes on a 100 division scale. Such an instrument will register currents not indicated on the meter used in the tests mentioned. This new meter will indicate a current flow as small as .0000001 ampere, or a tenth part of one microampere.) Observers will note that even the carrier waves of some local stations fluctuate within certain limits, although this fluctuation is never noticed during the regular process of reception.

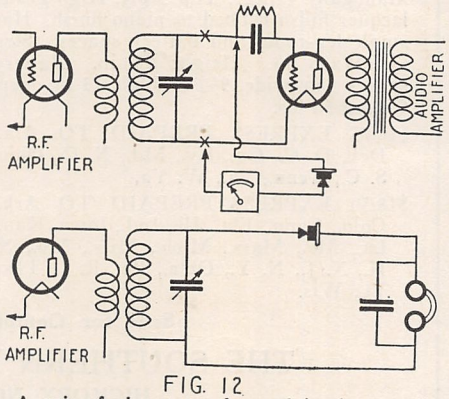


FIG. 12

A pair of phones can be used in the output R.F. circuit of an ordinary receiver for testing purposes, as shown above.

If it is desired to utilize an ordinary receiver for this work, it is necessary only to remove the tube from the detector socket and to connect the microammeter combination across the detector input condenser. This, however, limits the reception to the R. F. amplifier and the crystal circuit. Under these circumstances the input circuit of the A.F. amplifier can be replaced with a pair of phones, as in Fig. 12. The leads from the crystal and the microammeter are connected to the rotor and stator plates of the detector input-circuit condenser. This can be accomplished without fear of impairing the receiver's operation when the regular detector tube is inserted into its socket. The external indicating circuit leads can be clipped into place. Such connections will be satisfactory.

If the observer is determined to make the records worthwhile, it is necessary to record, at each period of observation, the time in hours and minutes, the weather conditions existing at the time the records were made and for several hours preceding the records. If possible, the time at the broadcasting station and the weather conditions existing at the transmitter and at points in the area between the receiver and the transmitter should be recorded, and also, if existing, any peculiar irregularities in solar or lunar activity.

ONE-WAY TRANSMISSION

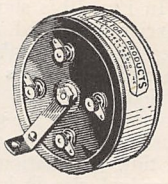
Said my neighbor, "Oh, Ben, can you lend
me an X?
I've burnt out the tubes in my set;
A little 10-spot would help me a lot,
And your kindness I'll never forget."
Now, I try, vainly try, to collect from that
guy,
And my troubles an angel would vex;
Like a blunderer dumb, with his set on the
bum,
I'm unable to get the D—— X!

—W. D. McClennan.

Build a VICTOREEN for real radio pleasure

A Victoreen Super has range, selectivity, volume and clarity.

Tens of thousands of fans build Victoreen sets every year. The results come up to full expectations.



VICTOREEN Transformers are the heart of the circuit — air core construction —tuned to 1-3 of 1% precision—use No. 170 for storage battery tubes—No. 171 for dry cell tubes. Each $7.00.

Other VICTOREEN Parts—

Rheostats. Large number of turns of wire—three terminal type. 2, 6, 10, 20, 30 ohms. Each $1.20.

Potentiometers, 200, 400 ohms, $1.50.

Master Control Unit. A compensating single control unit for sets using two or more condensers of equal capacity. Price $19.50. Extra condensers $4.50 each.

Audio Control Unit. Three rheostats of proper ohmage controlling detector and audio tubes. Each $4.50.

Ask your dealer or write direct for literature giving complete information.

The George W. Walker Co.
6528 Carnegie Ave., Dept. H.
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Guaranteed Performance at a 50% Saving!

World Storage "A" Battery

2-Year Guarantee Bond in Writing

ACKNOWLEDGED as the most reliable and economical "A" power known to radio, the "A" Storage Battery has yet to find an equal. Guaranteed performance proves it. No other method can give the same lasting satisfaction. For this reason, the World Radio Storage "A" Battery is the constant choice of thousands of set owners. *Solid Rubber Case.*

APPROVED and listed as standard by Radio News Lab., Pop. Sci Inst, Standards, Pop. Radio Lab., Lefax, Inc., and other famous radio authorities.

SEND NO MONEY—We ship same day order is received by Express, C. O. D. Batteries subject to examination on arrival. 5% discount for cash in full with order. Send today.

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SOLID RUBBER CASE RADIO BATTERIES
6-Volt, 100-Amperes $10.00
6-Volt, 120-Amperes $12.00
6-Volt, 140-Amperes $13.00

SOLID RUBBER CASE AUTO BATTERIES
6-Volt, 11-Plate $10.00
6-Volt, 13-Plate $12.00
12-Volt, 7-Plate $14.50

WORLD BATTERY CO., 1219 So. Wabash Ave. Dept. 10 Chicago, Ill.

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RADIO CATALOG

Dealers! Send for our new 1927 Catalog. Contains nationally advertised high quality sets, kits and parts.

Use your letterhead.

Western Radio MFG Co.
134-136 W. Lake St. Chicago, Ill.

Correspondence from Readers

(*Continued from Page* 1254)

me lots of bother, so I took the set to a so-called radio expert and, after a week's time, I was informed that the set was O. K. and that the charges was $7.00—which of course I had to pay in order to get the set. I was told that the set was as good as new, and given the usual lot of bunk, *viz.*: "If it isn't right, you tell us and we will make it right."

Well, to make a long story short, the set did not function as well as before. I was compelled to return it to the factory, and *they sent me a new set in return.* I had been fleeced out of $7.00 very easily.

Yes, there are radio repair grafters, and they seemingly are prospering.

C. F. KNOLL,
Sioux Falls, S. D.

(Our correspondent brings home the troubles to which manufacturers, as well as set owners and reputable dealers, are exposed by the activities of the incompetent, as well as the merely dishonest. The correspondence we have received, a part of which has been printed expressing different viewpoints, has borne out the importance of the radio purchaser's knowing with whom he does business. We believe the subject has now been sufficiently covered.—EDITOR.)

Super-DX Reception

(*Continued from Page* 1218)

building, with the aid of extension insulators. A short section of rubber hose is attached to the top of the tubing, permitting it to be connected easily to the nearest water spigot. Water is turned on for a few minutes before the set is used, the hose being disconnected from the tubing when the set is in use. The ground lead-in wire consists of No. 6 seven-strand insulated wire wound several times around the tubing, soldered and taped.

It is claimed that a ground equipment such as described above proves very effective in reducing static and power noises, when the ground wire is connected to the antenna binding post of the set.

The number of plates and the length of the ground tubing may be varied to suit individual preference, soil conditions, etc.

SOME STATIONS HEARD

Mr. Moskovita, who has been almost overwhelmed by fan letters since the publication of a partial description of his work in RADIO NEWS for January, writes that he has received cablegrams from some Australian broadcasters, whose programs he will endeavor to have rebroadcast this winter through one of his local stations.

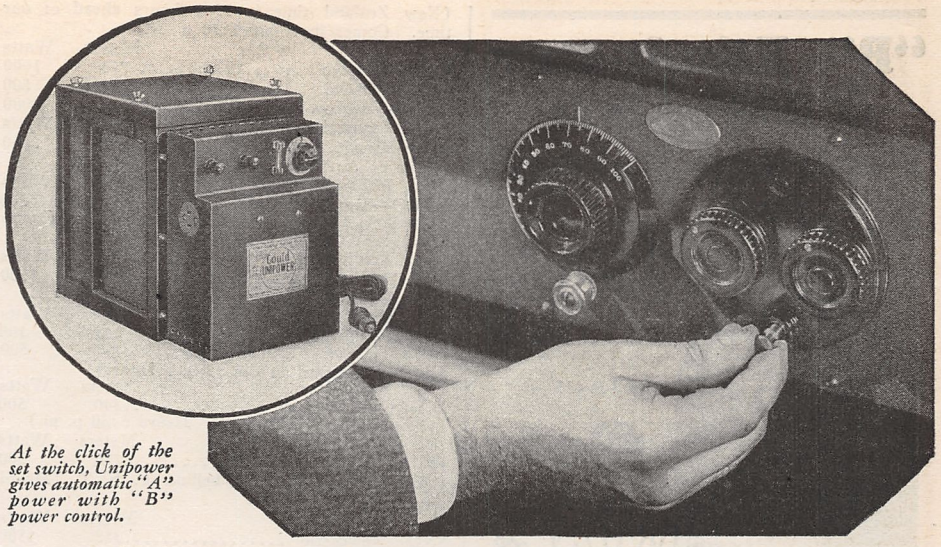
It is his experience that Australian and Japanese stations are received best between March and September. The former come in then with the greatest strength, as it is in the midst of their winter.

Below is a partial list of some of the stations in foreign countries that he has heard using a standard Super-Zenith receiver, model 7.

Australia	Meters	Watts
4QG—Brisbane	385	5000
3LO—Melbourne	371	5000
5CL—Adelaide	395	5000
2FC—Sydney	442	5000
2BL—Sydney	353	5000
3AR—Melbourne	484	1600
5DN—Adelaide	313	140

(Australian time is 18 hours ahead of our time. They come in best after 3:30 a.m. P.S.T.)

New Zealand	Meters	Watts
2YK—Wellington	285	120
1AR—Auckland	330	200
VLDN—Dunedin	310	500



At the click of the set switch, Unipower gives automatic "A" power with "B" power control.

The Simplest Way to run your RADIO

THE simplest way to run your radio set is to install Unipower. For Unipower not only gives you automatic "A" power from your light socket, but makes possible the entire control of your set and *all power by one switch*—the radio set switch.

There is no danger of forgetting to turn off your "B" power—Unipower takes care of it for you. You cannot forget to charge Unipower—an automatic switch connects it with your house current at the right time without your thinking of it.

Furthermore, a special Gould-designed Balkite charging unit in Unipower guards against damaging overcharge.

Unipower needs no care except the occasional replenishing of water, and even if you forget this, there is an automatic cut-off which prevents damage until water is added. It can be installed safely and easily in most consoles.

Thousands of Unipowers are simplifying the power problems of owners of all kinds of radios. Unipower is time-tested. You can depend upon it because it is built right—built by Gould, makers of quality batteries for motor cars, submarines and railways for thirty years. Ask your dealer about Unipower—he knows.

Gould Storage Battery Co., Inc.
250 Park Avenue New York

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A GOULD PRODUCT

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Potter condensers, American made of highest quality materials to full capacity, build the best Socket Power Devices, Power Amplifiers, Impedance Amplifiers. And they are best for Filter Uses, Rectifiers, By Pass, and Blocking D.C. All types and sizes.

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North Chicago, Illinois

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"B" Eliminator TESTING Problem Solved by Sterling

Model R-415

TO GET full value from your "B" Eliminator you must *know* that your "B" Power is delivering the *right* amount of voltage to detector, amplifier and power tube.

Low resistance voltmeters suitable for testing batteries are worthless for testing "B" Eliminators. This specially designed High Resistance Sterling is accurate for both.

Whether this voltmeter is used in your business or for your own set, it is *essential* if you want the facts about any "B" Eliminator. Also tests all D. C. circuits.

Sterling
R-415 VOLTMETER
A laboratory meter at the remarkably low price of
$8.50
THE STERLING MFG. CO.
2831 Prospect Ave. Cleveland, O.

LYNCH METALLIZED

WARRANTED FIXED RESISTORS

THE vital importance of a silent, accurate resistor cannot be overestimated. Comprising a concentrated metallized deposit one-thousandth of an inch thick, upon a glass core and sealed forever within the tube, each Lynch Resistor is warranted absolutely noiseless, permanently accurate, dependable! Guaranteed accuracy—10%; in production they average 5%. .25; .5; 1; 2; 3; 4; 5; 6; 7; 8; 9; 10 Meg., 50c. .025; .09; .1 Meg., 75c. Single mounting, 35c; Double, 50c. If your dealer cannot supply you, send stamps, check or money order. We ship postpaid same day order is received.

Dealers—Get on our mailing list; we keep you posted on new developments. Write us today!

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EVERYTHING IN RADIO
AT ATTRACTIVE PRICES. SETS OR PARTS.
Orders shipped exactly as ordered. Prompt Service.
Write for Prices. Mail Order Only. Write for Catalogue.
ALL RADIO COMPANY. 417 North Clark St., Chicago

(New Zealand time is 19½ hours ahead of our time. Comes in about 1:30 a. m.

Japan	Meters	Watts
JOAK—Tokyo	375	1000
JOBK—Osaka	385	500
JOCK—Nagoya	360	1000
Tasmania	**Meters**	**Watts**
7ZL—Hobart	516	3000

(Same as Australian time.)

Philippine Islands	Meters	Watts
KZRQ—Manila	370	500

(Manila is 16 hours ahead of Pacific time. Comes in after 5:00 a. m.)

South Africa	Meters	Watts
Cape Town	363	1500

(Heard at 4:15 a. m.)

Cuba	Meters	Watts
6KW—Tuinucu	338	100
PWX—Havana	400	500

(E. S. T. Heard in the early evening.)

Porto Rico	Meters	Watts
WKAQ—San Juan	340	500

(4 hours ahead of P. S. T. Heard 5:30 p. m.)

Hawaiian Islands	Meters	Watts
KGU—Honolulu	270	500

(Honolulu is 2½ hours behind P. S. T. Heard after 10:00 p. m.)

England	Meters	Watts
5NO—Newcastle	312	1500
2LO—London	361	3000
6BM—Bournemouth	326	1500
5WA—Cardiff	356	1500
2ZY—Manchester	384	1500
2BD—Aberdeen	500	1500

(Most of the English stations were received during the last International radio test week.)

South America	Meters	Watts
OAX—Lima, Peru	380	6000
LOO—Buenos Aires	330	500

(International Test Week.)
(9 stations in Mexico and 37 in Canada have also been received.)

FOREIGN CORRESPONDENTS

As will be seen from some of the letters reproduced above, Mr. Moskovita has verified reports of reception from these stations. Knowing that George V, of England, is very much interested in radio he wrote his majesty a letter telling of success in listening to English stations. Soon afterwards he received a letter which said in part, that "the King's Private Secretary is commanded to thank Mr. Moskovita for his letter and interesting data on wireless telephony."

Mr. Moskovita has received letters from all parts of the world where radio is known—and those where it is not are few in these days—one of the most interesting being from a Japanese radio fan named Takeo living near Tokyo. Mr. Takeo asked about some stations he had heard and in closing his letter said this:

"I beg you will henceforth favour me with your friendship in perpetuity. Kindly consent me my many entreatys. I am waiting with craned necks for your yearning reply."

It is such things as these, in addition to the pleasure derived from merely listening to the different selections, that make radio

Station
WRNY
NEW YORK
373.8 Meters - 802 kilocycles
is owned and operated by the publishers of this magazine
Our Editors will talk to you several times every week-See your Newspaper for details
TUNE IN ON WRNY

CARTER

"HI-OHM" Volume Control with Filament Switch

Half Size

SIX TYPES
10,000 to 500,000 Ohms.

$2.50
Complete with Knob

Popularity!

Here today and gone tomorrow. "The King is dead—long live the King"—to become popular is often a chance of fortune—but to remain popular year after year calls for really super-human effort. Yet year after year Carter have been the popular parts—the choice of the big majority—what volumes that fact registers and what a guarantee it gives to you.

Any dealer can supply

In Canada: Canada Radio Co., Limited, Toronto

CARTER RADIO CO.
CHICAGO MEMBER R.M.A.

THESE COILS IMPROVE ANY RADIO RECEIVER!

T.R.F. KIT **List $12.00**

This set of supersensitive Aero Tuned Radio Frequency Coils has never failed to improve the performance of any radio receiver. Tremendously increased power, extreme selectivity, and improved tone quality are sure to result from their use. This kit of Aero Coils has a much lower high frequency resistance than other types of inductances. You should use them in any circuit, if you want the best possible results.

FREE Big 8-page 4-colored layout system (actual size blue prints) and complete instructions for building the 5-tube Aero-Dyne Receiver free with each kit. Also insert showing how to wire for a power tube if desired. Extra copies, 75c each.

Get these Aero coils from your dealer. If he should be out of stock, order direct from the factory.

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CORWICO

AERIAL KITS

Corwico complete aerial kits include everything necessary for aerial, ground and hook-up requirements. They simplify the buying of antenna equipment and assure a good aerial and connections for best reception. Prices from $1.75 to $4.50. Higher priced kits include Brach Storm King Lightning Arresters.

Dealers and Jobbers—Write for proposition.

CORNISH WIRE COMPANY
30 Church Street New York City

something really worth while. It has been said—and we think truly too—that radio will prove in time to be a great factor in making international relationships more friendly. You can not stay angry for a very long time with a fellow that you have "worked" with by amateur phone or code, if he is a decent chap; and who knows but that the friendships formed from communications between the young men of different countries will some day bring about a better feeling between nations—that is of course if the politicians give them half a chance.

Does Resistance Coupling Give Best Quality?

(*Continued from Page* 1250)

fication we lose in the coupling unit depends on the design, as well as the frequency which we are amplifying, but we may take these figures as fair for the average resistance amplifier at frequencies not too low.

All this would be well if there were no other complications. We might convince ourselves that we can stand a loss of this amount to obtain better quality. Better to use an extra tube or two to bring the volume up, than use amplifiers of poor quality, giving high amplification but music not worth listening to. But we must not forget the condenser in the circuit. If none of the elements in the circuit varied with the frequency, we would be able to obtain perfectly undistorted reproduction out of the amplifier. The amplification would be exactly the same, no matter what the frequency of the note we wanted to amplify—bass-note, or otherwise.

EFFECT OF CONDENSERS

But unfortunately all the elements do not function independently of frequency. The resistances do, but the condensers do not. The condenser has a high reactance at low frequencies, and this decreases as the frequency becomes higher. The voltage V1 in Fig. 2B is divided between the condenser C and the grid-leak resistance rg. At low frequencies, when the reactance of the condenser is high, there may be a greater proportion of the voltage V1 across the condenser, where it does no good, than across the resistance rg, where it is impressed where we want it; that is, on the grid of the second tube.

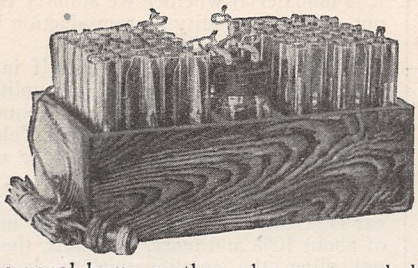
As the frequency becomes higher, the reactance of the condenser decreases; consequently the voltage across it becomes a smaller and smaller part of the voltage V1, and the part of this voltage across the grid leak resistance becomes greater and greater. In other words, even in the resistance-coupled amplifier we can expect poor amplification at low frequencies, and higher amplification at higher frequencies.

THE BOTTOM FREQUENCIES

The next thing to consider is, "How serious is this variation of the amplification, and what must we do to keep it small?" In order to answer this question let us look at Fig. 3. This shows the shape of the curve of actual amplification obtained in a resistance-coupled amplifier. The shape is very similar to that of a curve for a transformer-coupled amplifier. At the top of this figure is a broken line, which indicates the maximum amplification theoretically obtainable with a given combination of plate and grid resistances.

At very low frequencies the amplification is low, as we have seen before; it rises rapidly at first as the frequency is increased, and then becomes nearly horizontal, gradually approaching the theoretical maximum at very high frequencies. Now let us assume

90 volt "B" POWER UNIT



$12.75

ALREADY hundreds and hundreds have adapted this radically new Power Unit. Unconditional guaranteed not to produce the slightest trace of a hum, line noises, etc. Gives well known battery results with true eliminator simplicity minus the usual hums, costly replacements and doubtful results. Simply plug into your house socket and forget it! Works upon any 110- to 120-volt alternating current line and any cycle, even 25-cycle, which is the bugaboo of all eliminators. Costs approximately one-tenth cent per hour of operation. Comes complete—nothing to purchase extra. Contains no acid. Simpler to hook up than dry cells as all special detector voltages, intermediate and amplifying voltages are all plainly marked. Operates any 1 to 10 tube set.

Prices—only slightly higher than dry cells. Such true, smashing value—with absolute unbelievable results that my 5-year-old, 30-day trial offer refund applies, if it does not meet with your every desire. 90 volts $12.75, 112½ volts $15.25, 135 volts $17.50. Knock-down kits at still greater savings. Also built for 32-volt home lighting plants in any above sizes at only $3.00 additional. Special or higher voltages built to order. Ample stocks all packed—and same day shipments. Guaranteed for 2 years. Simply say—ship C. O. D. and we'll do the rest, or write for my literature, testimonials, etc.

New TRICKLE "B" CHARGER

Full-Wave, Noiseless type. Charges any wet, rechargeable "B" storage battery from 90 to 150 volts. Can be left on when receiving. No costly rectifying bulbs to break or burn out. Price $3.75 complete.

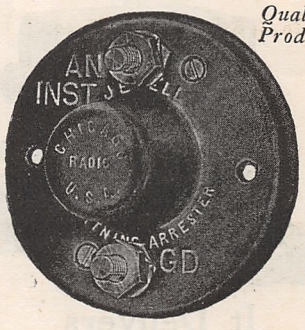
B. HAWLEY SMITH, 321 Washington Ave., Danbury, Conn., U. S. A.

Mfr. of "A" Power Units, "B" Power Units, "A" Storage Batteries, "B" Storage Batteries and "A" and "B" Chargers including Tricklers

JEWELL

A Quality Product

Protection



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Radio set protection from lightning is very essential. You never know when or where Lightning will strike. Your antenna may be one of the first struck this season.

The Jewell Lightning arrester is listed and regularly checked by Underwriters' Laboratories, thus insuring a uniform product with maximum protection to costly radio equipment.

Ask your nearest dealer to show you one or write us for descriptive circular No. 1019.

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Used in 50 big broadcasting stations 12,000, 48,000, 50,000 and 3,000 ohms. For distortionless amplification. Order a Crescent today at $1.50. Special sizes made to order. Discounts to dealers.

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For $10 you can get the finest loud speaker that money can buy—the new, perfected Dulce-Tone, the unit that utilizes all the scientifically developed, time-tested reproducing elements of your phonograph.

Dulce-Tone and your phonograph will improve the reception from any set. Greater volume, clearer tone, entire freedom from blare and distortion.

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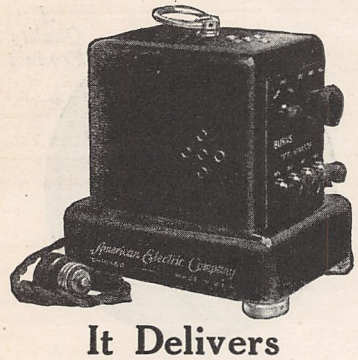
Enclosed is $10 for my Dulce-Tone. If I'm not satisfied after 10 days' trial, I'll return it and get my money back.
Name .....
Street .....
City .....State .....



It Delivers
FULL "B" VOLTAGE

Burns
B-Battery Eliminator

Operates from lighting current like other household appliances. No hum or vibrations. Smooth constant plate supply. Once connected it requires no further attention or adjusment.

Popular Price—Write for Data.

American Electric Company
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Makers of Burns Loud Speakers

Raytheon
LONG LIFE RECTIFYING TUBE

that there is a certain frequency below which we need not amplify. We will call this the "cut-off" frequency. It may be say, 50 or 60 cycles. We rarely encounter musical notes having frequencies lower than this; so it is immaterial whether we amplify them or not, as far as quality of reproduction is concerned.

The problem then resolves itself into this question, "How much drop in amplification can we tolerate at the cut-off frequency?" Dr. Harvey Fletcher of the Bell Telephone Laboratories has answered this for us. In one of his papers in the *Bell System Technical Journal* he has shown that the human ear is sensitive to changes of sound intensity of about 10% and more. We must, therefore, not allow the amplification to drop more than 10% in the entire amplifier, while the frequency is changing from a high value down to the cut-off frequency.

Note that I have said that this must be true of the *entire* amplifier. Where there are three stages used in the amplifier, the drop in amplification that can be tolerated *in each stage* is only 3.4%. This can be understood clearly when we remember that if we have a drop of 10% we must have available 90%, or 0.9 of the maximum voltage amplification. The cube-root of 0.9 is 0.966, which requires that for three stages, 96.6% of the maximum amplification be available in each stage. This means a tolerable drop of 100—96.6, or 3.4%. The requirements are, therefore, more stringent than one would ordinarily think. They are made more so because we have to use three stages in order to obtain sufficient amplification. If we had to use only two stages we could tolerate a drop of about 5% in each stage.

FUNCTIONING OF RESISTANCES

We will come back to this a little later on. Let us now consider the effects of the resistances in the coupling device. The prime requisite of an amplifier is to amplify; hence its name. We should so proportion the circuit elements so as to obtain as much amplification as possible, without introducing difficulties. The amplification can be made to approach the voltage amplification of the tube by

(1) Making the plate resistance r1 high.
(2) Making the grid-leak resistance rg high.

There are involved, in doing these things, limitations which are independent of the blocking condenser. So let us assume for the moment that the blocking condenser is so large that it offers negligible reactance to the alternating currents, or that the frequency is high, which amounts to the same thing. We should then have the conditions for maximum amplification with given combination of resistances. When either the condenser is large or the frequency is high, the circuit then reduces to that shown in Fig. 4A, for the reactance of the condenser is small and may be neglected. The equivalent circuit is shown in Fig. 4B. Note that 4B is the same as Fig. 2B with the condenser C short-circuited.

The whole of the voltage V1 is then impressed on the input of the second tube; that is, vg is equal to V1. This shows very clearly the effect of the condenser in influencing the amplification. The circuit is therefore the equivalent of an alternator in series with a resistance rp and a parallel arrangement of r1 and rg. From this arrangement it is possible to determine the maximum amplification possible with a given combination of resistances. This maximum theoretical amplification is equal to the resistance between the points *a* and *b* of Fig. 4B, divided by the sum of this resistance and the plate resistance rp, multiplied by the "mu" (amplification factor) of the tube. This gives the overall maximum amplification with this combination of resistances.

We may increase the plate resistance r1, in order to increase the amplification, but

Heavy-Duty RADIOHM for Simple Control of B-Battery Eliminator

A single turn of the knob gives full resistance variation to control eliminator's output voltages. Permanent resistance as adjusted. Insulated for 1,500 volts. **Approved by Raytheon Laboratories.** Outlasts eliminator, giving full efficiency from it.

$2 at dealer's, or from us.

Central Radio Laboratories
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Australian Representative—United Distributors, Ltd., Sydney.
Canadian Representative—Irving W. Levine, Montreal.
Great Britain Representative—R. A. Rothermel Ltd., London.
69 standard set makers use Centralab variable resistances.

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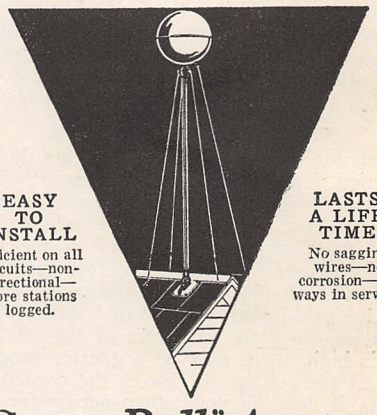

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the limitation to this lies in the "B" battery. When the plate resistance is high we are forced to use a very high-voltage "B" battery, which becomes unwieldy and costly. The value of r1 which has been found to work satisfactorily in practice, with 201A tubes, is about 10,000 ohms.

We may try to increase the amplification by making the value of the grid-leak resistance high; but when we do this we make it more difficult for the grid charge to leak off the grid. This is the very reason why we were forced to introduce the grid-leak resistance into the circuit, so we must be very careful about its value. If it is too high, the tube "chokes up"; there are likely to be grid "clicks" or even "howling" of the amplifier.

But even without considering the blocking of the grid, there is a practical limit to the resistance, beyond which it does not pay to go. It is shown in the paper previously referred to that, when using a tube having a plate resistance of about 10,000 ohms, and a resistance r1 of 10,000 ohms, little is gained in amplification by making the grid leak resistance higher than about a half a megohm.

Let us suppose then that we are going to adopt these values for our resistance-coupled amplifier. The next question is "How large should the condenser be so that the amplification will not drop more than 3.4 per cent. per stage at a cut-off frequency of 50 cycles?"

DESIGNING THE AMPLIFIER

It will not be possible to explain in this popular journal how this question is answered. For the technical details the reader is referred to the more technical paper. Let it be sufficient to say that when the circuit of Fig. 2B is analyzed, an equation can be derived from which the chart of Fig. 5 was plotted. This chart shows the relation between the grid-leak resistance and the capacity required in the resistance-coupled amplifier, in order that the amplification may not drop more than 10% in the *entire* amplifier, from the high frequencies to the cut-off.

To show how this chart is applied, take the present example, where rp is 10,000 ohms (which may stand roughly for a 201A tube) and rg is half a megohm. Also suppose there are three stages to the amplifier. By following the broken line upward from the point representing a half-megohm for rg, to the line marked "Three Stages," and then over horizontally, we find the capacity required in the condenser C.

It will be noted that this value is very much greater than that ordinarily used. It will also be noted that, if we wish to use a smaller condenser we may do so, provided we increase the value of the grid-leak resistance. But we may run into trouble by doing this as we have seen before, and the amplifier may start to "howl." The tendency to "howl" depends upon many things; and certain values of resistances and condenser which may cause one amplifier to howl may not cause such trouble in another. The condenser to be used should not become too large, either, as there are other difficulties involved, such as the "time lag" in the combination of condenser and grid leak. It may take too long for the condenser to charge up and pass the current through to the resistance; so that distortion may arise from this cause.

The main point of this whole discussion is that larger condensers must be used to make resistance-coupled amplifiers all that many believe or claim them to be; and that under no circumstances can "perfect" reproduction be obtained with them. They can, however, be made so "perfect" that the human ear cannot detect the departure from perfection, but this can be done only by the sacrifice of amplification, and use of additional stages. "All is not gold that glitters" and "All resistance-coupled amplifiers are not distortionless amplifiers."

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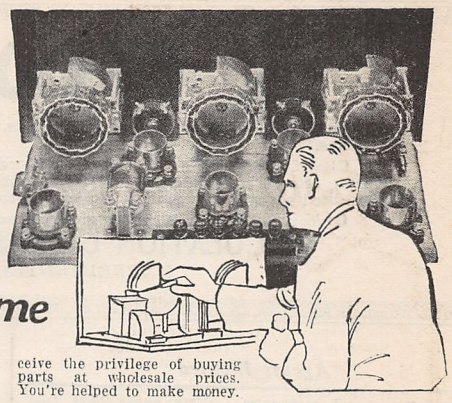

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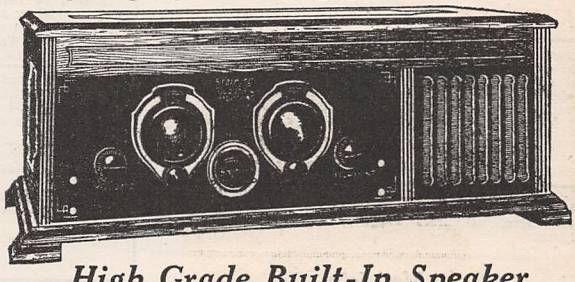

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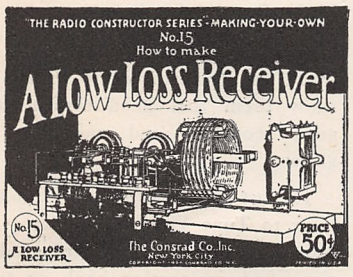

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By ROBERT HERTZBERG

RADIO: BEAM AND BROADCAST, by A. H. Morse, A.I.E.E., M.I.R.E. D. Van Nostrand Company, New York, N. Y. 5½x8½ inches, 192 pp. cloth, Price $4.00.

This is a complete and interesting history of radio and its numerous patents. It is complete in that it traces the development of the science from 1678, when Christian Huygens, a Dutch mathematician and physicist, propounded the undulatory theory of light, right down to 1925 and the widespread adoption of radio broadcasting as a means of entertainment; and it is interesting in that it reveals the vitally important work done by men whose names mean little even to many experienced radio enthusiasts. The book is completely lacking in technical discussions and in explanations of the various systems of communication of which it treats, the author evidently assuming (probably correctly) that his readers have studied the technical phases of radio and are desirous of learning more of the historical side of the "game."

The opening paragraphs of the book are worth quoting. Mr. Morse writes:

"In connection with patents of invention, there is a somewhat commonly used metaphor to the effect that one cannot get a patent on the use of an umbrella to keep off the sun. This, however, cannot be said to apply to the radio art; for instance, J. A. Fleming was awarded a perfectly good patent on the application to radio of a well-known effect and instrumentality; and H. H. C. Dunwoody secured an equally good one on the similar application of a hitherto unsuspected property of carborundum. In each case the invention was of a high order of commercial utility; since the former led to one of the great developments in the evolution of the art, while the latter sustained the art during one of the most needy periods of its application to commerce, and is still in extensive use.

"The evolution of radio has been characterized by comparatively few original inventions of outstanding merit and commercial utility; and by fewer still that, for one reason or another, have found any practical application, until they were about ten years old."

The men whose contributions to radio are chronicled by Mr. Morse are Joseph Henry, Heinrich Ruhmkorff, James Clerk Maxwell, D. E. Hughes (his successful demonstration of radio communication, given in 1879, is particularly stressed), A. E. Dolbear, Thomas A. Edison, Heinrich Hertz, Edouard Branly, Oliver Lodge, Nikola Tesla, Elihu Thomson, A. S. Popoff, Ernest Rutherford, Guglielmo Marconi, S. G. Brown, Ferdinand Braun, Valdemar Poulsen, Dr. A. Wehnelt, J. A. Fleming, R. A. Fessenden, H. H. C. Dunwoody, Lee de Forest, Ettore Bellini and Alessandro Tosi.

After reading the unbiased recital of each man's accomplishments, the radio fan, to whom radio is synonymous with "Marconi," is forced to draw the rather disturbing conclusion that Marconi has received more credit for the "invention" of radio telegraphy than he really deserves. Without in any way deprecating the Irish-Italian's indispensable contributions to the art, it may be stated that the real foundation of radio was laid by scientists who never basked in the glare of popular publicity. This sentiment has been expressed in no mincing terms a number of times by radio iconoclasts able to convince magazine editors of the authority of their evidence.

To quote Mr. Morse again: "It is to be regretted that some one did not give to Hughes the encouragement and facilities for practical experiment which, nearly twenty years later, the late Sir William Preece gave to Marconi."

The book also contains much enlightening material on the regenerative patent situation, over which a much-involved controversy is still raging, and on the development of the vacuum tube.

Exactly half of *Radio: Beam and Broadcast* is devoted to reproductions of important radio patents. There are some twenty given, along with illustrations of the various systems described. These patents are especially interesting, for their dates show that many radio inventions which people think are now "new" are actually years old. Thus the Marconi beam transmitter, which has been made the subject of considerable newspaper pub-

This Book and Magazine section will appear in each issue of RADIO NEWS, and contain reviews of the new publications of interest to radio students, from the beginner to the most advanced. It will be found a useful guide to intelligent purchasing. For the benefit of our readers, contemporary periodical offerings, both American and foreign, will also be briefly listed.

THEN

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7 30~Discovers set wont work,

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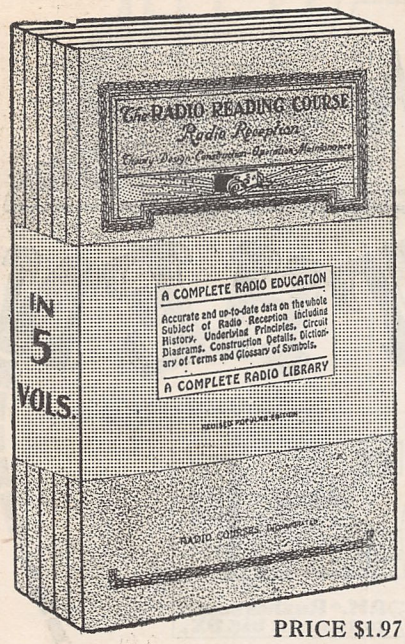

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licity recently, actually was conceived in fundamental form thirty-one years ago, in 1896 to be exact! Also, the "reflex" system of double-frequency amplification, as well as the principles of tuned radio frequency amplification, are covered in a 1913 patent to two Germans, Schloemilch and Bronk.

A study of the patents is almost a radio education in itself. The systems described are the following: Braun's parabolic reflector, 1902; De Forest's parabolic reflector, 1902; Marconi's parabolic reflector, 1917; Marconi's transmitter and receiver, 1896; Marconi's parabolic reflector, 1896; Marconi's elevated and grounded aerial, 1897; Lodge's syntonic system, 1897; Lodge's coupled-circuit receiver, 1898; Braun's coupled-circuit transmitter, 1899; Marconi's syntonic system, 1900; Tesla's synchronous discharger, 1896; Edison's diode, 1883; Fleming's diode, 1904; De Forest's amplifier, 1906; De Forest's triode detector, 1907; Schloemilch and Bronk's triode amplifier and reflex circuit, 1913; Franklin's regenerative receiver, 1913; Armstrong's regenerative receiver, 1913; Round's autodyne, 1913; Arco and Meissner's relay, 1914; Elihu Thomson's arc, 1892, and Poulsen's arc, 1903.

EVERYDAY ELECTRICITY, by Herbert T. Wade. Little, Brown, and Company, Boston, Mass. 5 x 7½ inches, 299 pp. cloth.

There seems to be almost as many "beginner's" books on electricity as there are women's hats in Paris; but, as with the hats, there always seems to be a demand and place for them. Thousands of young men, with the view in mind of making electrical engineering their life work, read such books as preparatory home training for either a regular school education or for further advanced home study; thousands of more mature men, already practising a trade or profession, read them as a matter of amateur interest. The advent of radio broadcasting with the possibilities it offers as an absorbing hobby has further increased the demand for elementary works, for, as has been stated many times, radio is merely one branch of the science of electricity, and no one can understand a single thing about radio until he has first acquired a speaking acquaintance with the fundamental principles of electricity and electrical practice.

Herbert Wade's book, broadly titled *Everyday Electricity*, fills the requirements of the seeker of radio knowledge,—the man or boy interested enough in radio to spend a few fruitful hours with an accurate but at the same time understandable book. Only half a dozen of the entire three hundred pages contain any mention at all of radio or radio apparatus, a fact which makes this recommendation of the volume somewhat puzzling; however, let the statement again be repeated that all radio actions are electrical actions in new applications. The chapters in the book, dealing with the generation of current by primary and secondary batteries, apparently mean nothing so far as the reproduction of dance music by a broadcast receiver is concerned; but, if the reader studies them diligently, he will know how "A" and "B" batteries work and how and why they develop trouble. If he studies the chapter on induced currents and absorbs the information contained therein, he will understand how radio-frequency transformers, audio-amplifying transformers, output transformers, "B" eliminator transformers, and all other transformers operate.

The twenty-one chapters of *Everyday Electricity* deal briefly and concisely, in absolutely non-mathematical terms, with the following subclassifications: electricity, its fundamental nature; static electricity—electricity "at rest"; the magnet and magnetism; generation of current—the voltaic cell; electrical units and measurements; induced currents; storage batteries; generators and motors; direct and alternating current; the telegraph; the telephone; electric lighting; applications of electrical energy; the transmission and distribution of electrical energy; electricity and transportation; electricity on shipboard; electric heating; electrochemistry and electric furnace; electric waves; X-rays; lightning.

In the chapter on electric waves the author deals briefly with the discoveries of Joseph Henry, James Clerk Maxwell, Lord Kelvin (William Thompson), Armand Fizeau and Heinrich Hertz, and describes the method of generating radio waves by means of the Hertz oscillator. Mr. Wade very sensibly realizes the difficulty (if not the impossibility) of covering even part of the detailed field of radio in a general book on electricity, so he generously refers his readers to John V. L. Hogan's companion volume, entitled *The Outline of Radio*, which was reviewed in the previous issue of RADIO NEWS.

Although it has little connection with radio, except possibly in that telephone lines and equipment are extensively used in nightly "chain" broadcasts, the chapter on the telephone is highly interesting. In it is explained, in easily understood language, the operation of telephone systems, of both the "manual" type, involving the employment of central operators, and the machine-switching variety, popularly but inaccurately known as "automatic" phones.

Everyday Electricity is one of "The Useful Knowledge Books", edited by George S. Bryan. It is illustrated with numerous line drawings and photographs. It is to be highly recommended to the person to whom the word "thermogalvanometer" is still something to puzzle over, but it is just a little elementary for the amateur experimenter who can already distinguish a potentiometer from a rheostat.

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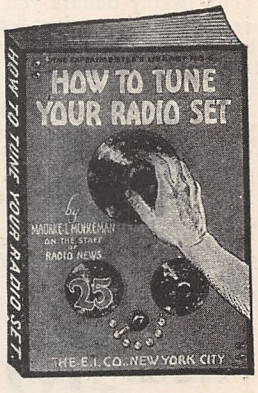

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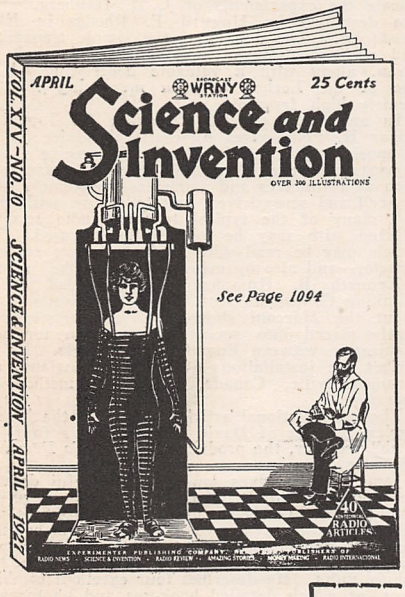

Here is a list of the most important articles in the April issue of Science and Invention:

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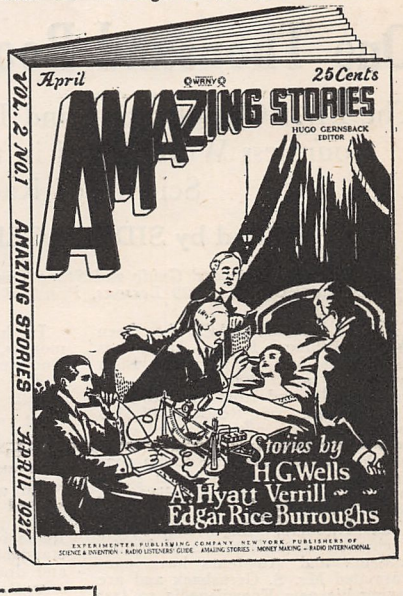

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CURRENT RADIO ARTICLES

POPULAR RADIO, New York, February, 1927.

Reflex circuits, we thought, were completely dead and buried, in the United States at least, but they seem to be undergoing rejuvenation. In the January numbers of two radio magazines David Grimes revived his once-popular "inverse duplex"; and now in *Popular Radio* Morris M. Silver describes the All-Amax Senior, a three-tube reflex employing (glory be!) a good old-fashioned crystal detector. This receiver comprises two stages of R.F. amplification, one stage of reflexed A.F. and one stage of straight A.F. The antenna and first R.F. circuits are tuned by regular inductances and variable condensers, a fixed R.F. transformer (another revival) being employed between the second tube and the crystal detector. The audio output of the crystal circuit is turned back into the preceding tube (the second one), which thus acts as both R.F. and A.F. amplifier. The amplified audio-frequency component of its plate current is passed through the primary of another audio transformer, which feeds the third and last tube, acting entirely as an A.F. amplifier.

The outfit is simple and cheap and will probably appeal to many jaded radio constructors as a welcome relief from the huge shielded, multi-stage sets that have been in vogue. The only problem is the unreliable crystal. If the present day detectors are any better than those available three years ago, the receiver will undoubtedly enjoy a more or less widespread adoption; if they are no better, it is likely to prove a disappointment.

In another article Lawrence M. Cockaday gives constructional data on a quality amplifier consisting of one stage of transformer- and two stages of impedance-coupled amplification. This unit may be installed in an old-style receiver to bring it up to date or may be used in a new model with which the constructor is experimenting.

Other general articles are: 'The Coming of the 'Radio University' "; in which Bruce Bliven discusses the educational possibilities of broadcasting; "Is Radio Broadcasting Killing the Wild Savageries of Jazz?", by Earl Reeves; "Radio a la carte," a slightly idiotic but exceedingly funny contribution by Arthur L. Lippmann; and "The Fight Against Distortion," by Raymond F. Guy.

RADIO BROADCAST, Garden City, L. I., February, 1927.

Advanced radio experimenters who have already had some experience with the usual "short waves" employed for amateur transmission (those in the 20-, 40-, and 80-meter bands), can drop still further down the scale to 1 meter if they care to duplicate the experiments of J. H. Hallberg, which are described by Howard E. Rhodes in *Radio Broadcast*. The details of the simple transmitter and receiver designed for 300,000 kc. work are given, along with a valuable description of the use of the Lecher wire in measuring this extremely high frequency.

In an article entitled "Looking for Trouble?" Edgar H. Felix gives some useful advice on the diagnosis and cure of ailing radio receivers. He suggests the use of suitable testing instruments, such as voltmeters and ammeters, earphones, small dry-cell and screwdriver, and tells how, with their aid, many of the typical troubles radio sets are afflicted with may be located and cleared. The article may be read with profit by every set constructor—and also by many radio "service" men.

Kenneth B. Humphrey, in the lead article, "Linking Continents with Twenty Kilowatts," tells about the Marconi short-wave beam system, recently placed into successful operation for communication between England and Canada. He describes the installations at Bodmin, England, and Drummondville, Canada, and their methods of operation.

The constructional articles deal with the inverse duplex receiver of David Grimes, and a four-tube "Lab" receiver, the product of the *Radio Broadcast* laboratory.

James Millen gives some highly useful data on the combination of various kinds of audio amplifiers with different power-supply systems, and tells particularly how to overcome the "motor-boating" trouble which is common to resistance- and impedance-coupled audio amplifiers working with "B" supply units. He describes four excellent combinations, of which detailed hook-ups and photographs are reproduced.

The interesting subject of "A.C. As a Filament Supply Source" is discussed by Benjamin F. Meissner, who has done considerable research work along this line. Radio fans who have often wondered why alternating current cannot be used directly on tubes will find this article illuminating.

QST, Hartford, Conn., February, 1927.

The leading articles in the February number of *QST* are for the most part continuations of a series started a month or two back. In "How Our Tube Circuits Work," Robert S. Kruse describes at length the Colpitts circuit, and explains its action in great detail. David Grimes expounds further his inverse duplex receiver and gives constructional data for the main components of the set. For the

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transmitting ham there are articles on a crystal-controlled transmitter and on an airplane transmitter.

Probably the most interesting story in the magazine is one by "The Old Man," a mysterious character in amateur radio who has for years amused the fraternity with his tales, all the titles of which start with the word "Rotten." He has been silent for a long time, but now breaks into print again with a story entitled "Rotten Reasons." Though not as hilarious as previous efforts, it is a real "ham" story nevertheless.

MODERN WIRELESS, London, England, January, 1927.

Perhaps it is because the crystal detector is so completely passé in the United States that this reviewer always reads with mild amusement the long and detailed discourses on crystals contained in the various British radio magazines. Of course, he realizes that radio conditions and practices across the sea are entirely different from those which American fans enjoy, but the crystal articles afford him enjoyment nevertheless.

In *Modern Wireless,* for instance, four pages are devoted to "Curious Crystal Circuits." No less than nine arrangements are shown; these range from a simple combination of a tuning coil, crystal and phones to a hook-up involving three variable condensers and two double-winding tuners. And, believe it or not, a loop-operated set is also shown, although the author of the article admits that the reception the outfit gives can hardly be described as successful.

Tube sets by no means are excluded from the magazine, three receivers, employing from two to five bulbs, being described in detail.

WIRELESS WORLD AND RADIO REVIEW, London, England, January 12th, 1927.

This bright little weekly offers its readers a variety of radio articles, on both technical and popular subjects. The technical material includes a description of apparatus for measuring the fading of radio signals, and also a write-up of the "Wireless World Five," a shielded five-tube set of up-to-date design.

Some of the regular departments of the magazine are entitled: "Editorial Views," "Novelties from Our Readers," "Current Topics," "Hints and Tips for New Readers," "The Set Builder," "Broadcast Brevities," "New Apparatus" and "Readers' Problems."

QST FRANCAISE, Paris, France, January, 1927.

The distressingly mathematical nature of the majority of the technical articles in *QST Français,* the leading publication of France, leads one to inquire if all French radio fans are graduate engineers who walk around with slide-rules and tables of logarithms in their hands. Certainly no radio enthusiast possessing the technical knowledge of the average American experimenter, or even that of the advanced student, can read these articles and understand what they are all about. Among the subjects treated are: "The Radiophone and Its Propagation Phenomena," "Radio Crystals," "Filters for Power-Supply Units," "Calculation of Inductance," and the "Construction of a Thermo-Coupled Ammeter."

A detached blueprint containing constructional data on a three-stage power amplifier is furnished with the January number of the magazine.

FUNK, Berlin, Germany, January 14th, 1927.

Containing two equal sections of technical matter of interest only to experimenters and detailed programs of interest to non-technical listening fans, this German weekly caters to a wide audience. The technical half contains articles on such familiar subjects as the parallel operation of loud speakers and earphones, the use of resistance-coupled amplification with various types of tuners, a home-made "B" battery, etc. The program section contains mention of the daily offerings of practically all the European broadcast stations.

RADIO UMSCHAU, Frankfurt am Main, Germany, January 16th, 1927.

This is another combination technical-program weekly. The lead article is a very complete description of the Baird television system, and includes some fine wash drawings showing the details of the complicated mechanism used by the Scotch inventor.

This issue also contains a description of a nine-tube superheterodyne employing the modulation idea found in the American "ultradyne." The front panel of the set is rather interesting to behold, for in addition to two condenser and two potentiometer dials, it holds nine separate rheostats, one for each tube. The receiver is probably a "family" outfit; that is, it requires the services of the whole family for its tuning.

DER DEUTSCHE RUNDFUNK, Berlin, Germany, January 16th, 1927.

Consisting in the great part of station programs and write-ups of radio performers, this magazine has comparatively little appeal to the experimentally inclined radio fan. It contains a few constructional wrinkles and some suggestions on the use of direct current house supply instead of "B" batteries, but little else in the way of experimental data.

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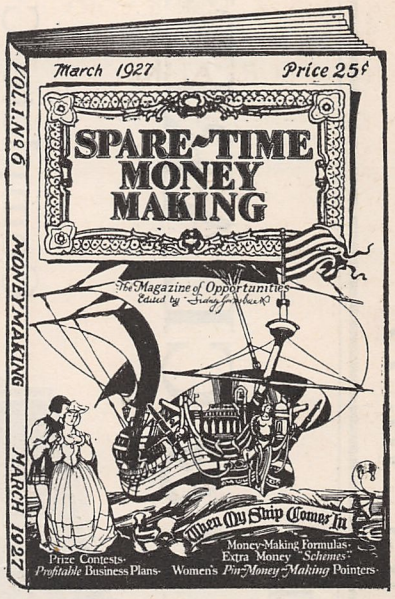

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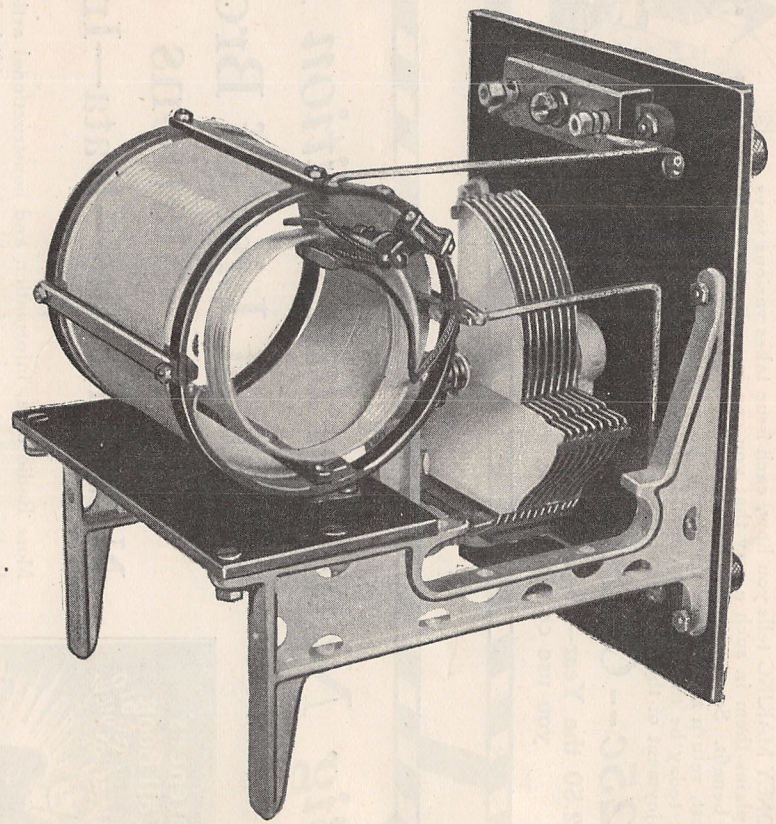

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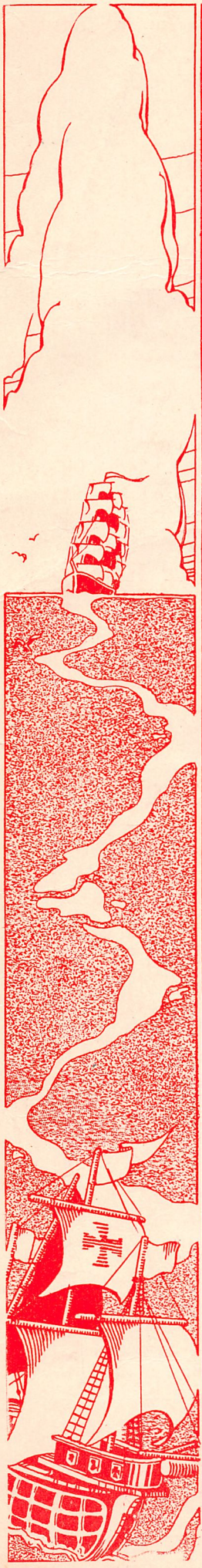
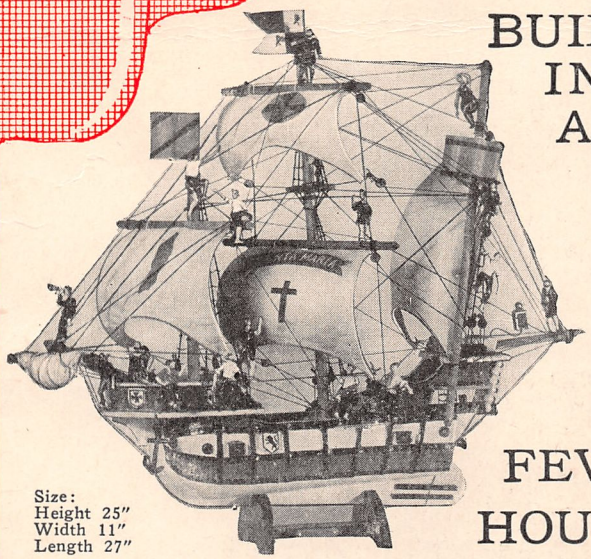


COST $4.98 — wins 1st prize — COST $4.98

BUILD IN A FEW HOURS



Size:
Height 25"
Width 11"
Length 27"

1492

SANTA MARIA
DISCOVERY OF AMERICA

Size:
Height 25"
Width 9"
Length 27"

1620

MAYFLOWER
PILGRIM SHIP

The Santa Maria pictured above was entered in the model contest held by the Publishers of Science and Invention Magazine by Mrs. C. J. Bierbower of 3216 Baring Street, Philadelphia, Pa., and was chosen by the Judges from among hundreds of other models for its Beauty and Simplicity of Construction. Mrs. Bierbower built this Prize Winner from a set of Our parts costing $4.98. No extra or special parts were added to those supplied by us.

YOU CAN BUILD A PRIZE WINNER FROM OUR PARTS

Shipped direct from the factory of the World's Largest Builders of Ship Models

We supply you with every part needed to complete the model and a full detailed diagram and instruction sheet, showing and explaining every operation, including painting and rigging.

This model is made of well seasoned wood; every part is cut to fit and ready to put in place. No tool is needed but a small hammer.

You can order one or both of these models. They can be assembled in a few hours.

MINIATURE SHIP MODELS
BARING ST. at LANCASTER AVE.,
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You Can Make Big Profits Assembling and Selling These Ship Models.
Order Your Model Today

Miniature Ship Models,
Baring St. at Lancaster Ave.,
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Please send me the completed parts, cut to fit, and ready to assemble for the Model.....
I will pay Postman $4.98, plus postage (a few cents).

PLEASE PRINT NAME AND ADDRESS PLAINLY TO AVOID DELAY

Name .....

Street or R. F. D. .....

City .....

State .....

BY AIRPLANE OR MULE-BACK

There's a radio station in Honduras, six thousand feet high, upon a mountain top. They use Radiotrons there, high power Radiotrons, for transmission. More than once in an emergency, the Radiotrons have had to be delivered by airplane. Usually they are carried up the rough mountainside by mule-back.

These great Radiotrons cost a few hundred dollars apiece, and as not many "spares" can be kept on hand at that price, each one must perform exactly to standard—each one must be sturdy of build in spite of its delicate accuracy.

The laboratories that design these high power transmission tubes, design the Radiotrons you use. The same factories make them. The same test laboratories test them. RCA produces the tubes for all sorts of high power transmission and learns from these tubes many a lesson of making and testing that gives you a better Radiotron for your receiving set! Benefit from this experience by using only genuine RCA Radiotrons, no matter what *type* of tube you use.

RCA

RADIO CORPORATION OF AMERICA
New York Chicago
San Francisco

Every tube in your set counts!

Every tube in your set has its "finger in the pie." The faint signal that comes in from the broadcasting station goes through each tube, and it's magnified hundreds of thousands of times before it gets to the loudspeaker.

It's not only important to get the "special" Radiotrons that give you bigger distance and bigger volume. But it's just as important to stick to genuine Radiotrons straight through the set, if you want to keep up its performance. RCA research makes Radiotrons better and better every year!

Bring your storage battery set up-to-date with
a *power* RADIOTRON UX-171 or UX-112
a *detector* RADIOTRON UX-200-A
and RADIOTRONS UX-201-A for all-round quality.
Bring your dry battery set up-to-date with
a *power* RADIOTRON UX-120
and RADIOTRONS UX-199 for all-round quality.

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA